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FLOOD PLAIN INFORMATION, CUYAHOGA RIVER, CITY OF KENT AND FRANK--ETC(U)
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FLOOD PLAIN INFORMATION

CUYAHOGA RIVER

CITY OF KENT

AND FRANKLIN TWP

PORTAGE COUNTY

OHIO



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OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATER

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TRI-COUNTY REGIONAL PLANNING COMMISSION

BY

CORPS OF ENGINEERS, U.S. ARMY
BUFFALO DISTRICT

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This report is based on hydrological facts, historical and recent flood heights, and technical data having a bearing on the occurrence and magnitude of floods within the study area.

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INTRODUCTION

In many areas of the Country the prospect of using protective works to alleviate possible flood damages effectively has reached the point of diminishing returns. This increase in flood damage potential, despite great expenditures on flood control, is greater than it ever was and is the result of rapid growth of flood damageable developments in the flood plain, occurring at a rate greater than that of providing flood control works. Flood damages have affected man's environment significantly. They have threatened his life and health, his property, his business or his place of employment. An obvious solution to this problem is to exercise greater wisdom in the use of flood plains. However, such wisdom cannot be exercised unless there is adequate knowledge of the flood hazard and a will on the part of the users of the flood plains to plan with the hazard in mind. Effective, sound land use in floodable areas through the use of regulatory powers has not been used extensively until recent years but is now receiving greater acceptance. It is now time to accelerate and enforce sound land use regulations in order to reduce future flood damages. Because man is powerfully attracted to the use of flood plain areas, Flood Plain Management practices are not likely to eliminate flood damages completely. However, they certainly can reduce them and therefore, should be given consideration by both planners and local governments.

This flood plain information report on the Cuyahoga River and Breakneck Creek through the City of Kent and township of Franklin has been prepared at the request of the Tri-County Regional Planning Commission through the Ohio Department of Natural Resources. It will be distributed to local interests through both of the above agencies.

The objective of this report is that the data contained herein will be used as a guide by the planners and local officials for

effective and workable legislation for the control of land use within the flood plain. In order that this objective may be obtained this report is intended to provide planners and local governments with technical information on the largest known floods of the past and to present data on possible future floods, such as, the Intermediate Regional Flood and the Standard Project Flood. The Intermediate Regional Flood has a frequency of occurrence in the order of once in 100 years, which means that over a long period of say 500 years, the magnitude of this flood would probably be equalled or exceeded five times, or on the average of once every 100 years. A flood of this magnitude is simply defined as having a one percent chance of being equalled or exceeded in any given year. The Standard Project Flood is a rare occurrence and, on most streams in Ohio, is considerably larger than any flood that has occurred in the past. The area referred to as a flood plain in this report, is the area that would be inundated by the Standard Project Flood. The frequency of occurrence of the Standard Project Flood is rare. However, it is recommended that when development within the flood plain is planned, consideration be given to the levels of possible future floods, including the Standard Project Flood.

This report is based on hydrological facts, historical and recent flood heights, and technical data having a bearing on the occurrence and magnitude of floods within the study area.

Included in this report are maps, profiles, photographs, and cross sections which indicate the extent of flooding that might occur in the future. These data, if properly used, can be very beneficial in wise flood plain management. From the maps, profiles, and cross sections in this report the depth of the Intermediate Regional Flood or the Standard Project Flood may be determined at any location. Based on this information, future construction may be planned high enough to avoid flood damages or, if at lower elevations, with recognition of the chances and hazards of flooding. In either case, the risks involved and the alternatives available should be considered.

This report does not include plans for the solution of flood problems. Rather, it is intended to provide the basis for further study and planning on the part of local governments within the study area in arriving at solutions to minimize future flood damages. This can be accomplished by local planning programs to guide essential developments by controlling the type of use made of the flood plain through zoning, building codes, health regulations and other regulatory methods. Another means in which local flood plain management can be accomplished is through public acquisition of land for a low development use such as recreation.

Pamphlets and guides pertaining to flood plain regulations, flood proofing, and other related actions have been prepared by the Corps of Engineers. They are made available for use by State agencies, local governments and citizens in planning and taking action to reduce their flood damage potential.

The Buffalo District of the Corps of Engineers will, upon request, provide technical assistance to Federal, State and local agencies in the interpretation and use of the information contained within this report and will provide other available flood data related thereto. Information available includes high water mark elevations, bench marks, and sample flood plain regulations.

SUMMARY OF FLOOD SITUATION

This flood plain information study covers the area along the Cuyahoga River from the West Kent City line, stream mile 52.65, to Lake Rockwell in Franklin Township, stream mile 58.10. This study also covers Breakneck Creek from its confluence with Cuyahoga River to the East Franklin Township line, stream mile 3.40. These communities are in Portage County. Their locations are shown on plate 1.

Presently there are eight U. S. Geological Survey water-stage recording stations in the Cuyahoga River basin. The locations of these gaging stations are shown on plate 1. The study area is located between the "Hiram Rapids Gage" which measures the flow from a drainage area of 151 square miles and the "Old Portage Gage" which measures the flow from a drainage area of 404 square miles. The "Hiram Rapids Gage" is located just downstream of Winchell Road bridge in an area known as Hiram Rapids and has records available from August 1927 to December 1935 and from October 1944 to the present. The "Old Portage Gage" is located 230 feet upstream of the Akron-Peninsula Road bridge about four miles northwest of Akron and has records available from September 1921 to December 1935 and from March 1939 to present.

Local government officials and property owners adjacent to Cuyahoga River have been interviewed, and newspaper files and historical documents have been searched for information concerning past floods. From these data and studies of possible future floods on the Cuyahoga River, both the past and future flood situation has been developed.

HISTORICAL FLOODS - Historical documents indicate that the ravages of flooding were first experienced in the area as early as 1832 when high water washed out a dam and several industries along the river. However, because of the dependency of existing industries

on water power, development adjacent to the river continued. A severe blow was dealt to the community by a flood in March 1913. Many industries suffered excessive damage, and a dam and portions of railroad tracks were washed away.

THE GREATEST FLOOD - The greatest known flood recorded on the Cuyahoga River at the Hiram Rapids and Old Portage gages occurred on 23 January 1959. Based on existing development, its peak flow at the Hiram Rapids gage has a frequency of occurrence in the order of once in 25 years and at the Old Portage gage is in the order of once in 200 years.

INTERMEDIATE REGIONAL FLOOD - The Intermediate Regional Flood is a flood that has an average frequency of occurrence in the order of once in 100 years. Peak discharges during an Intermediate Regional on the Cuyahoga River are estimated as 4,900 cfs at the Hiram Rapids gage and 5,820 cfs at the Old Portage gage. Prorating the discharges by using drainage area ratios, it was determined that the Intermediate Regional Flood would have a peak discharge of 5,300 cfs at the downstream end and 5,200 at the upstream end of the study area. The Intermediate Regional Flood on Breakneck Creek was determined to have a peak discharge of 2,200 cfs. Table I compares the Intermediate Regional and Standard Project Floods at selected locations in the study area.

STANDARD PROJECT FLOOD - The Standard Project Flood is a flood resulting from a severe combination of meteorological and hydrological conditions that is considered reasonably characteristic of the drainage basin under study. The Standard Project Flood is not assigned a frequency. Its water surface is considered by the Corps of Engineers to be the upper limit of the flood plain. Estimated Standard Project Flood discharges and stages at selected locations are listed on table I.

MAIN FLOOD SEASON - The highest discharges recorded in the Cuyahoga River at the Old Portage and Hiram Rapids gages normally occur between December and April. However, it is possible for flooding to occur in any month of the year. Flooding during the winter and spring months is normally the result of melting snow accompanied by moderate amounts of rainfall. Intense local thunderstorms during the summer and fall can also produce flooding.

FLOOD DAMAGE PREVENTION MEASURES - The areas in the study area have had a relatively small amount of flood damage in the past. This is rather fortunate, and to insure that flood damage remains at a minimum, effective flood plain regulations should be enacted and enforced to protect others from unwisely developing in flood hazard areas. The Tri-County Regional Planning Commission can assist in the drafting of flood plain legislation.

The Buffalo District, Corps of Engineers has initiated preparation of a "Cuyahoga River Restoration Study" to examine the potential and means of restoring the Cuyahoga River to a condition that best fits the environmental needs of the basin. The study will consider the total problems of the basin and recommend alternate solutions to them.

Runoff from the upper Cuyahoga River basin above this study area is modified by three main reservoirs. These reservoirs, shown on plate I, serve dual purposes: domestic and industrial water supply and flood control. They have been partially financed with Federal funds. The three reservoirs are:

(a) East Branch Reservoir - is located north of Burton on the Cuyahoga River and regulates river flow to Lake Rockwell Reservoir, the principal water supply reservoir of the City of Akron. The federal share of total costs was \$258,000. The reservoir impounds about 4,600 acre-feet of water and subtends a drainage area of about 18 square miles.

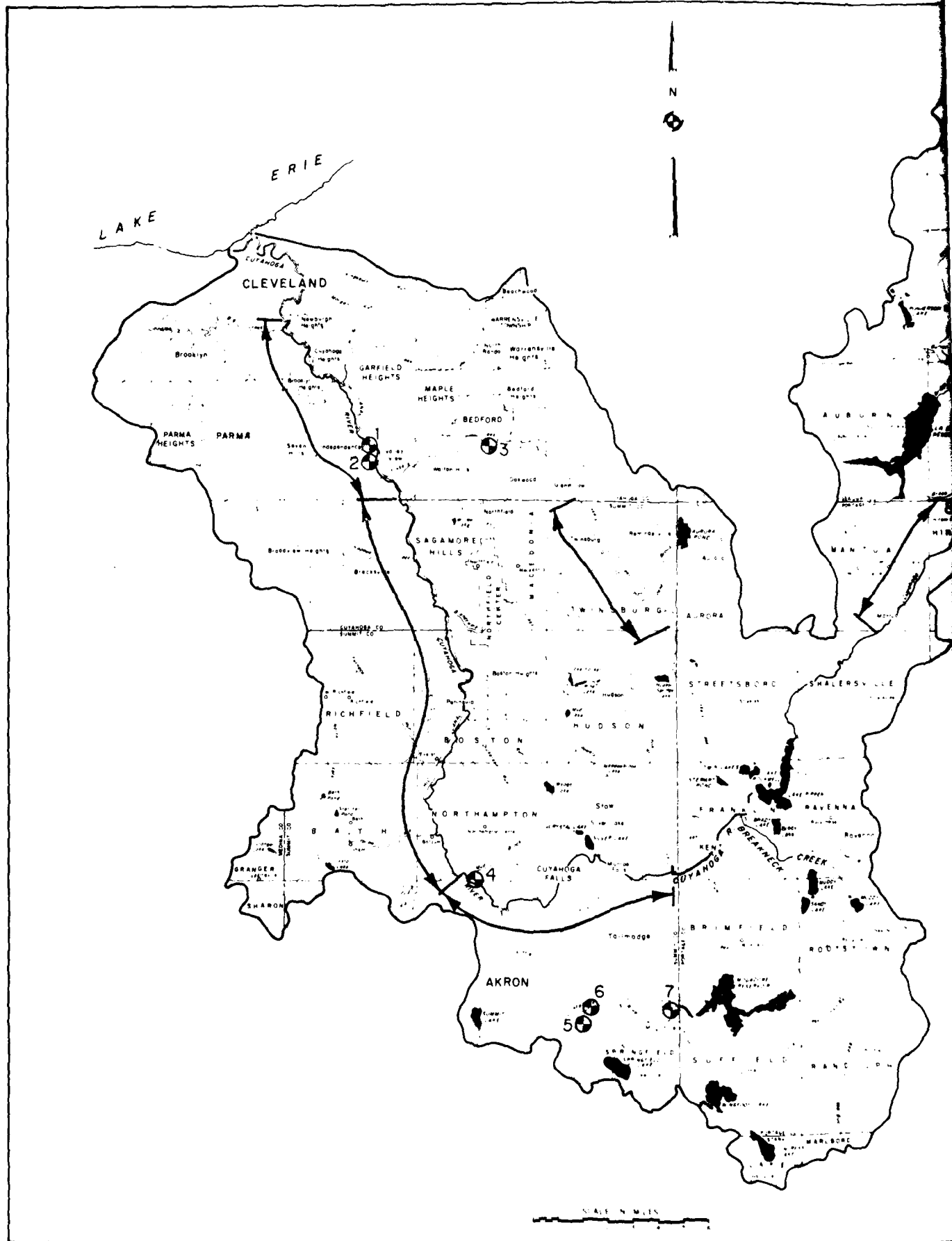
(b) LaDue Reservoir - Is located just north of Hiram Rapids and controls about 30 square miles of drainage area. This reservoir was also constructed by the City of Akron for water supply.

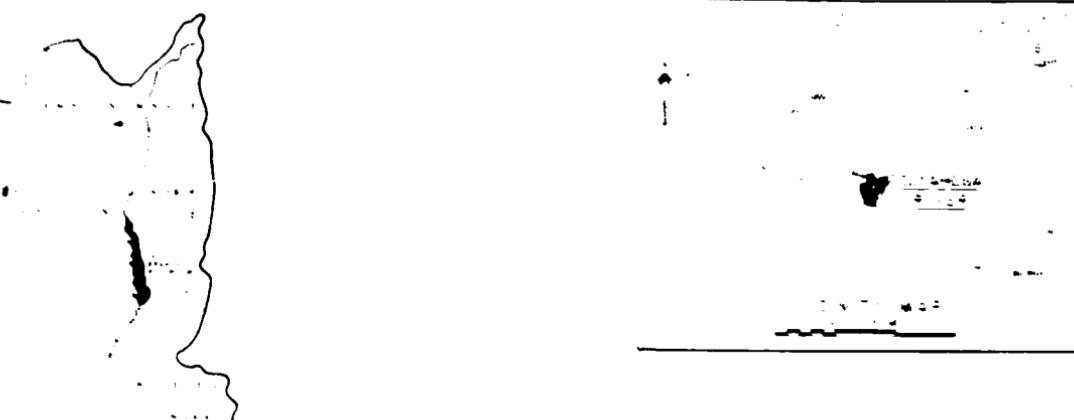
(c) Lake Rockwell Reservoir - Is located on the Cuyahoga River about two miles northeast of Kent and was constructed by the City of Akron for water supply. It controls about 205 square miles of drainage area and has a considerable modifying effect on floods in the upper basin.

POSSIBLE FLOOD HEIGHTS - Flood levels that would be reached by the Intermediate Regional and Standard Project Floods are shown on table 1. The water surface profile for the Intermediate Regional Flood, and the Standard Project Flood are shown on plates 9 and 10.


VELOCITIES OF WATER - Estimated average channel velocities of the Cuyahoga River during a major flood such as the Intermediate Regional Flood would vary from approximately 3 to 10 feet per second. Velocities in the overbank areas would vary from approximately 0 to 3 feet per second. Velocities of the Standard Project Flood would be somewhat higher. The velocities for these two floods at selected locations are given in the "Future Floods" section of this report. Velocities are normally considered hazardous to life and property when the depth is greater than three feet and the speed exceeds three feet per second.


HAZARDOUS CONDITIONS - Past floods have caused numerous hazards to local residents. Since many of the past floods have occurred in late winter or early spring, residents may suffer illness and discomfort from lack of heat for a number of days if basement flooding extinguishes furnace fires. In a flood, health problems frequently develop when septic tanks and municipal sewage treatment facilities are taxed beyond their capabilities. Flood waters overtop roads and cause hazardous driving conditions. The amount of damage caused by any flood depends upon the type and extent of development, how much area is flooded, the depth of flooding, the duration of flooding, and the velocity of flow.





LEGEND:

 BLUE LINE AND DATES FIELD COVERED BY THIS STUDY

 AUTHORIZED AND COMPLETED FLOOD PLAIN INFORMATION STUDIES WITHIN THE CUYAHOGA RIVER BASIN

- ⊕ U.S.G.S. WATER-STAGE RECORDING GAGE
- 1 CUYAHOGA RIVER AT INDEPENDENCE
- 2 OHIO CANAL AT INDEPENDENCE
- 3 TINKERS CREEK AT BEDFORD
- 4 CUYAHOGA RIVER AT OLD PORTAGE
- 5 SPRINGFIELD LAKE OUTLET AT AKRON
- 6 LITTLE CUYAHOGA RIVER AT MASSILLON ROAD, AKRON
- 7 LITTLE CUYAHOGA RIVER AT MOGADORE
- 8 CUYAHOGA RIVER AT HIRAM RAPIDS

CUYAHOGA RIVER
CITY OF KENT AND
FRANKLIN TOWNSHIP, OHIO
FLOOD PLAIN INFORMATION REPORT

BASIN MAP

U.S. ARMY ENGINEER DISTRICT, BUFFALO
MAY 1972

PLATE 1

TABLE I
RELATIVE FLOOD HEIGHTS IN THE STUDY AREA

Location	Mile Above Mouth	Flood	Estimated Peak Discharge (cfs)	Above Intermediate Regional Flood (feet)
<u>Cuyahoga River</u>				
Middlebury Road	52.80	Intermediate Regional Standard Project	5,300 32,500	0 8.6
Stow Street	54.75	Intermediate Regional Standard Project	5,250 30,900	0 17.0
West Main Street	55.00	Intermediate Regional Standard Project	5,250 30,900	0 9.0
Crain Avenue	55.35	Intermediate Regional Standard Project	5,250 30,900	0 14.0
Penn Central RR	57.78	Intermediate Regional Standard Project	5,200 22,200	0 14.1
<u>Breakneck Creek</u>				
Erie-Lackawanna RR	0.25	Intermediate Regional Standard Project	2,200 13,200	0 14.4
East Main Street	1.60	Intermediate Regional Standard Project	2,200 13,200	0 11.5
Powder Mill Road	3.00	Intermediate Regional Standard Project	2,200 13,200	0 10.9

GENERAL CONDITIONS AND PAST FLOODS

GENERAL - This section of the report is a history of past floods on the Cuyahoga River in the study area.

THE STREAM AND ITS VALLEY - The Cuyahoga River drains a "U" shaped basin approximately 809 square miles in northeastern Ohio. The basin shown on plate 1 includes parts of Cuyahoga, Geauga, Medina, Portage, Stark and Summit Counties. The river rises about ten miles northeast of Burton, Geauga County, and flows in a southerly direction to near the village of Hiram Rapids, then southwesterly and westerly, passing through Mantua, Kent, and Cuyahoga Falls to its confluence with the Little Cuyahoga River at Akron, thence northerly to Lake Erie at Cleveland. The total drainage area upstream of the U.S.G.S. gage at Hiram Rapids is 151 square miles, or about 19% of the total Cuyahoga River drainage area. The total drainage area upstream of the U.S.G.S. gage at Old Portage is 404 square miles, or about 50% of the total Cuyahoga River drainage area. The main tributaries of the river are: Big, Mill, Tinkers, Yellow, Brandywine, and Chippewa Creeks, Mud Brook, Furnace Run, Little Cuyahoga River, Breakneck Creek (Congress Lake Outlet) and West Branch Cuyahoga River.

The watershed consists of rolling hills except for the gently sloping area about three miles wide bordering Lake Erie. The Cuyahoga River rises at about elevation 1,300 feet above mean sea level and discharges into Lake Erie at about elevation 570.0. Upstream of Cuyahoga Falls, the Cuyahoga River cuts through glacial drift and is relatively flat with a fall of about four feet per mile. At Cuyahoga Falls the river cuts through Pennsylvania sandstone and drops 220 feet in 1.5 miles. In the lower northward course, the river flows in a pre-glacial valley with a fall of about five feet per mile. In the reach between the mouth of Tinkers Creek and the head of navigation in Cleveland, the channel falls 25 feet in 10 miles.

Most of the residential, commercial, and industrial development in the study area is located on ground above the flood plain.

Table 2 shows various drainage areas within the Cuyahoga River basin.

STREAM GAGING RECORDS - Presently there are eight gaging stations in the Cuyahoga River basin maintained by the U. S. Geological Survey. The study area lies between two gaging stations for which records are available. They are at Hiram Rapids and Old Portage. The drainage areas upstream of these gage sites are 151 and 404 square miles, respectively. The record of stages and discharges at these sites began in August 1927 and September 1921, respectively. Annual reports published by the United States Geological Survey furnish the average daily discharges in cubic feet per second, the maximum and minimum instantaneous discharges, and the maximum and minimum water stages. An annual publication "Water Resources for Ohio, Part I" is available from the U. S. Geological Survey office in Columbus, Ohio. In recent years, several of the continuous water-stage recorders that produce a graphic representation of the rise and fall of the water surface with respect to time have been replaced by digital-type recorders. A digital-type recorder punches onto a paper tape the stage at a selected time interval permitting the direct computerization of stream flow data. The time interval at which the stage is punched onto the the tape is selected such that a stage hydrograph (See Glossary) can be adequately defined. The U. S. Geological Survey also maintains staff gages. A staff gage, a graduated scale anchored vertically on the stream bank, provides a visual determination of the water surface at any given time.

Pertinent drainage areas of the Cuyahoga River and its tributaries are given in table 2.

TABLE 2
DRAINAGE AREAS WITHIN THE CUYAHOGA RIVER BASIN

Location on Cuyahoga River	:	Drainage Area Up- stream of Location (square miles)
Mouth	:	809
Big Creek junction	:	749
Mill Creek junction	:	710
Independence Gage	:	707
Tinkers Creek junction	:	597
Chippewa Creek junction	:	565
Brandywine Creek junction	:	528
Furnace Run junction	:	480
Yellow Creek junction	:	443
Mud Brook junction	:	433
Old Portage Gage	:	404
Little Cuyahoga River junction	:	340
Breakneck Creek junction	:	211
Breakneck Creek at the mouth	:	78.7
Hiram Rapids Gage	:	151
West Branch Cuyahoga River junction	:	41.4

SETTLEMENT

The present territory of Franklin Township was bought by Aaron Olmstead and supposedly named after his son in 1798. He then sold it off at a large profit. Franklin Township was formally organized in 1815.

What is now Kent was originally composed of two villages; Carthage and Franklin Mills, called upper and lower villages. Kent officially became a city after the 1920 census yielded a population figure of 7,070.

The falls of the Cuyahoga River provided potential water power and was an incentive for settlement.

The first settlers were John Haymaker and his wife who came in 1805 and were soon followed by others. Two dams were constructed on the river to furnish water power and in 1807, the Haymakers built the first grist mill. Many factories and mills followed and by 1840 the population of Franklin Township was 1,497.

POPULATION - Figure 1 illustrates the population trends for the individual communities in the study area. Since 1950, the population has increased 112%.

DEVELOPMENT IN THE FLOOD PLAIN - The location of the study area relative to the Cuyahoga River Basin is shown on the basin map on plate 1. While the flood plain area is relatively undeveloped as yet, the rapid population growth indicates that developing land in the flood plain will become an attractive course of action to meet the population demands of the area. It is imperative that specific flood plain regulations be adopted now so that future development will not be on lands that have been flooded in the past or may flood in the future.

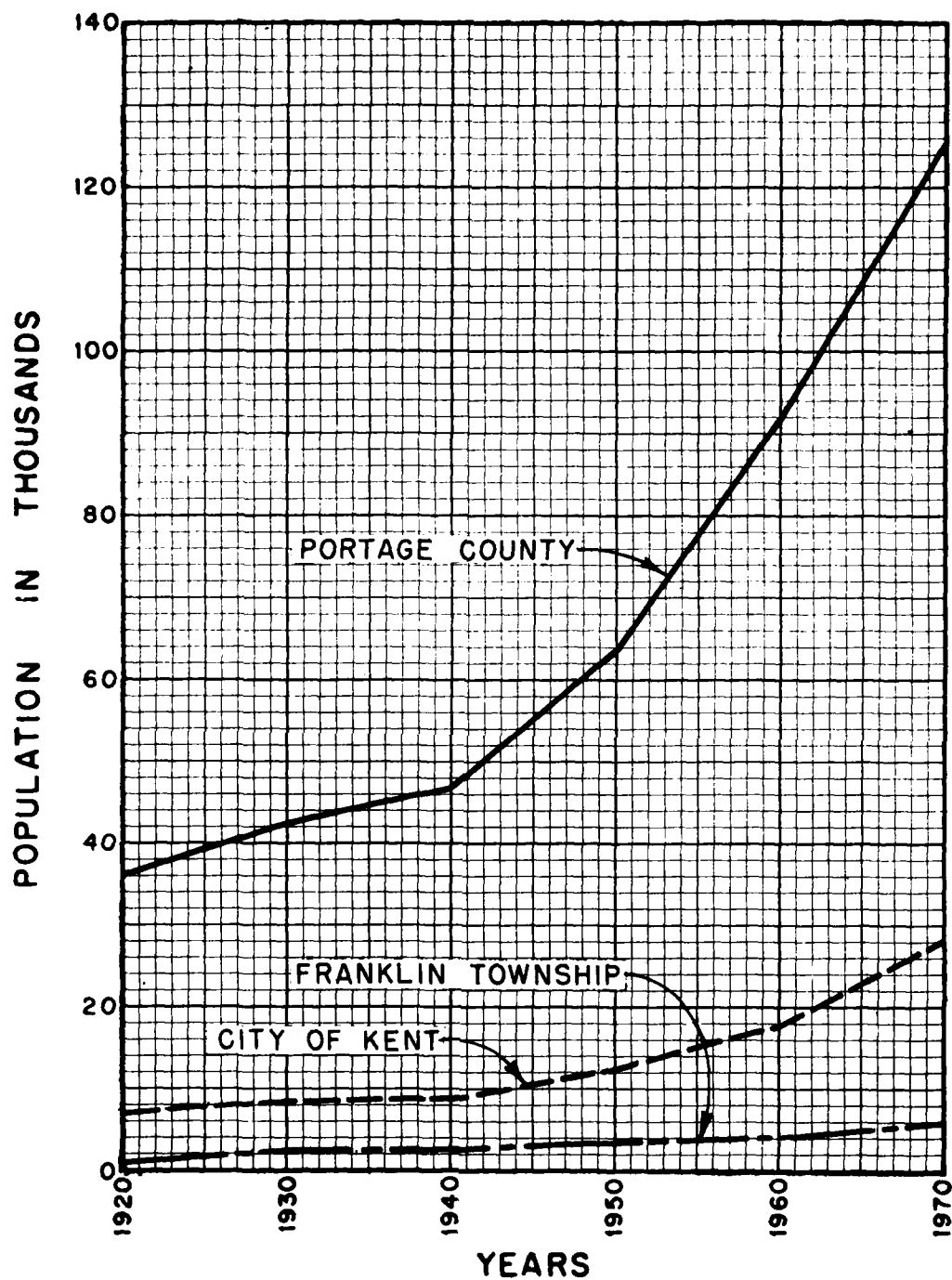


FIGURE 1

EXISTING REGULATIONS - There are no effective flood plain regulations in the study area. However, specific flood plain regulations could control development within the flood plain to be compatible with wise flood plain usage. Such regulations may be made possible by counties, municipalities, and townships under their regular zoning and building codes statutes. Samples of flood plain regulations passed in communities throughout the country are available at the Buffalo District office.

This report provides local governments with information on which to base their regulations.

In the State of Ohio, the power to adopt and enforce zoning regulations is delegated to political subdivisions. The enabling statutes are sections 303.02, 519.02 and 713.07 of the revised code. The General Assembly of the State of Ohio has passed an amendment to House Bill No. 314 that states all department and agencies of the State shall notify and furnish information to the Division of Water on State facilities which may be affected by flooding. This information is required in order to avoid the uneconomical, hazardous, or unnecessary use of flood plains in connection with State facilities. The amendment further reads that where economically feasible, departments and agencies of the State and political subdivisions responsible for existing publicly owned facilities shall apply flood proofing measures in order to reduce potential flood damage. Under Executive Order 11296, the Federal Government has similar restrictions in that all executive agencies directly responsible for the construction of Federal facilities shall evaluate flood hazards when planning the location of new facilities. In addition, this order requires that executive agencies responsible for the administration of Federal grant, loan or mortgage insurance programs shall evaluate flood hazards in order to minimize potential flood damage and the need for future Federal expenditures for flood protection and flood disaster relief.

TABLE 3
BRIDGES ACROSS CUYAHOGA RIVER AND BREAKNECK CREEK

Mile :	Stream :	Under- clearance :	Floor Elev. (1)	Standard Project Crest (2)	Intermediate Regional Crest (2)
Above :	Bed :				
Mouth :	Elev. :	Elev. :			
: Cuyahoga River					
52.80: Middlebury Road	1004.2	1014.3	1018.2	1024.4	1015.8
53.95: Norfolk & Western RR	1000.5	1023.1	1052.4 (3)	1026.8	1016.5
54.05: Kent Waste Water Pipe	999.2	1013.7	1018.2 (4)	1026.8	1017.0
54.18: Norfolk & Western RR spur line	1001.3	1022.7	1025.3(5)(3)	1028.3	1017.0
54.45: Fuller Park Road	1000.8	1017.0	1018.8	1029.0	1017.0
54.75: Stow Street	1006.3	1024.2	1028.7	1034.3	1017.3
55.00: West Main Street	1015.5	1045.9	1052.5	1043.0	1034.0
55.35: Crain Avenue	1021.5	1052.4 (5)	1062.2 (5)	1051.0	1037.0
57.65: Penn-Central RR	1026.9	1058.3	1069.8 (3)	1054.5	1040.7
57.75: Ravenna Road	1025.8	1037.0	1041.9	1055.0	1041.0
57.78: Penn-Central RR	1024.6	1045.6	1055.5 (3)	1055.5	1041.4
: Breakneck Creek					
0.25: Erie-Lackawanna RR	1028.2	1055.4	1065.1 (3)	1055.0	1040.6
0.45: Brady Lake Road	1031.2	1067.4	1071.9	1055.5	1040.6
1.00: Baltimore and Ohio RR	1034.0	1047.5	1056.2 (3)	1058.3	1045.9
1.60: East Main Street	1036.7	1045.2	1049.8	1059.3	1047.8
3.00: Powder Mill Road	1039.0	1050.5	1052.2	1061.6	1050.7

(1) All floor elevations are referred to centerline of bridge except where noted.

(2) All elevations are referred to the upstream side of the respective bridges.

(3) Top of rail elevation.

(4) Top of pipe.

(5) Taken at left abutment.

FLOOD WARNING AND FORECASTING SERVICES - The study area is well within the effective range of the Weather Surveillance Radar which is operated continuously by the National Weather Service at the Cleveland Airport and the Akron-Canton Airport. This equipment provides for the early detection and plotting of heavy precipitation and makes possible immediate radio and television broadcasts of information concerning the predicted path and amount of rainfall from the storm.

BRIDGES - There are eight highway bridges, six railroad bridges, one foot bridge, and one pipeline bridge in the reach covered by this study. Table 3 lists pertinent data for these structures and shows the relationship of the Intermediate Regional Flood to the Standard Project Flood.

Water surface profiles shown on plates 9 and 10 should be helpful to local officials in any future construction of new bridges or alterations of existing bridges. At any new bridges there should be sufficient clearance for drift and debris which usually accompany high water. Figures 2 through 17 are photographs of the bridges.

DAMS - There are two dams on the Cuyahoga River in the study area. One at stream mile 54.96 and one at the outlet of Lake Rockwell, stream mile 58.10. Photographs of these dams are shown on figures 18 and 19.

OBSTRUCTIONS TO FLOOD FLOWS - Inadequate bridge areas, abandoned dams, encroachments, and fills are some of the obstructions to flood flows. Other serious obstructions are bends in the stream, irregularity of channel section, and heavy brush, weeds, and large trees growing on the channel banks and extending into the stream. Figures 20 and 21 show typical obstructions in the study area, which tend to reduce floodway capacity and increase river stages.

To keep obstructions to flows at a minimum, each community should establish maintenance programs for streams within their area.

For example, highway crews during slack periods could remove fallen trees, shoals, and debris that may have collected in the channel. A concentrated effort should be made by the people not to throw refuse or other matter into the streams. The local government should establish a floodway, a strip of land on either side of the river that is kept free of obstructions to flows. Flood flows have come in the past and they will come again. A floodway provides extra room when high water comes.



Figure 2 Upstream face of Middlebury Road bridge,
stream mile 52.80.

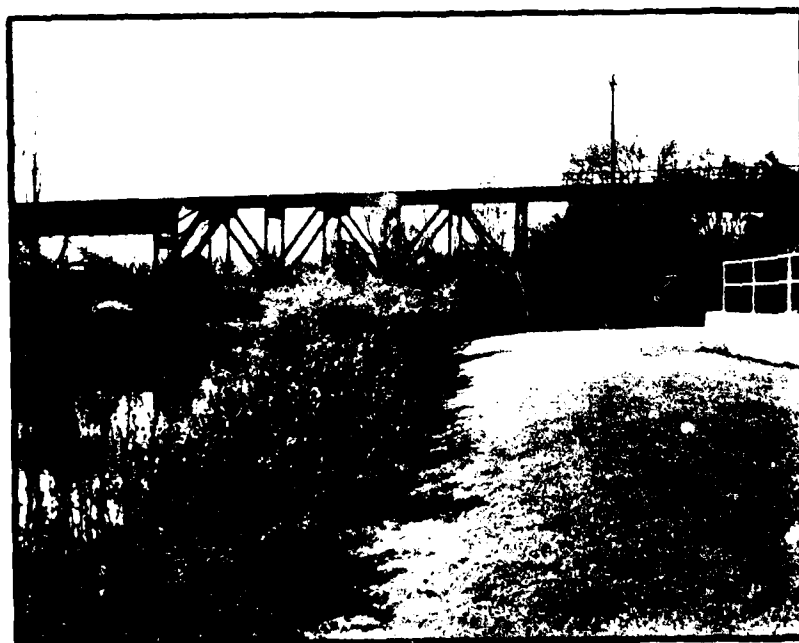


Figure 3 Upstream face of Norfolk and Western Rail-
way bridge, stream mile 53.95.

Typical bridges on the Cuyahoga River
Photographs taken in November 1971



Figure 4 Downstream face of Kent Wastewater Pipe bridge, stream mile 54.05.

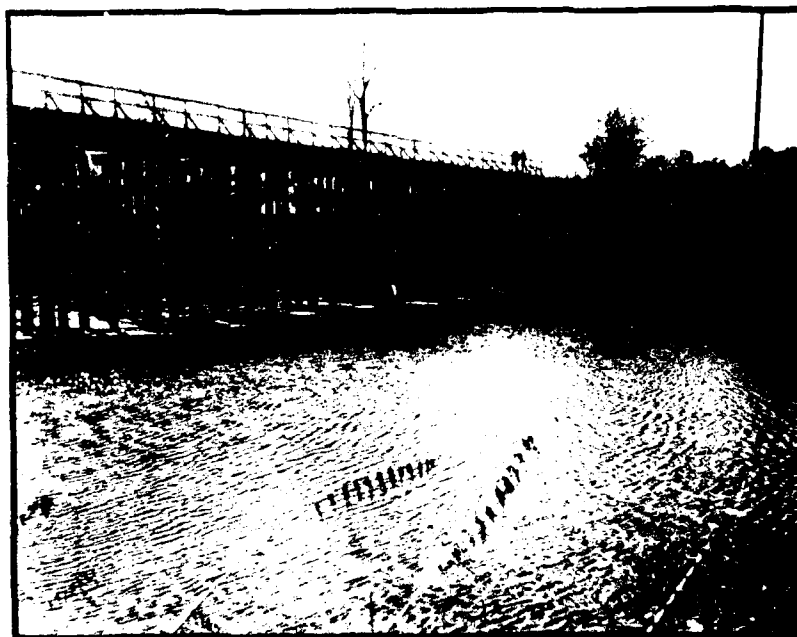


Figure 5 Upstream face of Norfolk and Western Railway bridge, stream mile 54.18.

Typical Bridges on the Cuyahoga River
Photographs taken in November 1971



Figure 6 Upstream face of Fuller Park Road bridge,
stream mile 54.45.



Figure 7 Downstream face of Stow Street bridge,
stream mile 54.75.

Typical Bridges on the Cuyahoga River
Photographs taken in November 1971



Figure 8 Downstream face of West Main Street bridge,
stream mile 55.00.

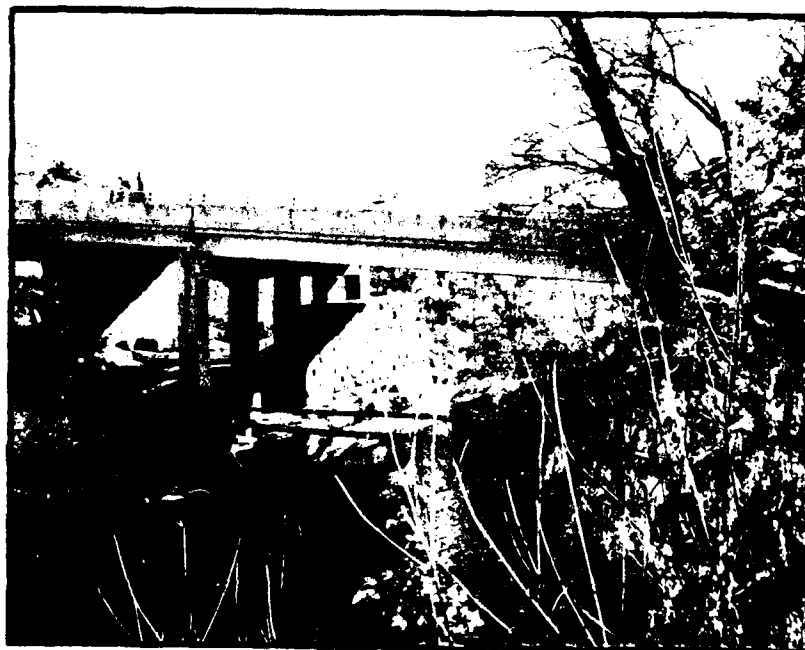


Figure 9 Upstream face of Crain Avenue bridge, stream
mile 55.35. Note pipelines which are obstructions to
high flows.

Typical Bridges on the Cuyahoga River
Photographs taken in November 1971



Figure 10 Upstream face of the Penn Central Transportation Company railroad bridge, stream mile 57.65.



Figure 11 Downstream face of Ravenna Road bridge, stream mile 57.75.

Typical Bridges on the Cuyahoga River
Photographs taken in November 1971



Figure 12 Downstream face of Penn Central Transportation Company railroad bridge over the Cuyahoga River at stream mile 57.78.



Figure 13 Upstream face of Erie - Lackawanna Railroad bridge over Breakneck Creek at stream mile 0.25.

Typical Bridges
Photographs taken in November 1971



Figure 14 Downstream side of Brady Lake Road bridge,
stream mile 0.45.

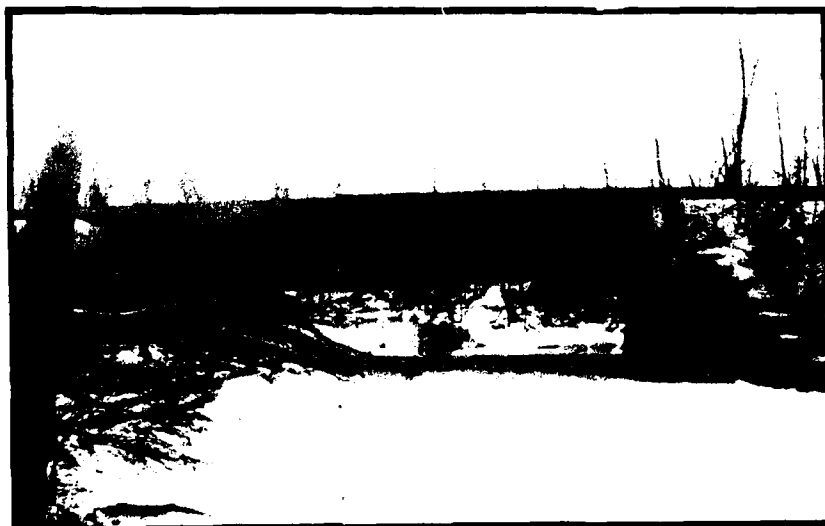


Figure 15 Downstream face of Baltimore and Ohio Rail-
road bridge, stream mile 1.00

Typical Bridges on Breakneck Creek
Photographs taken in November 1971

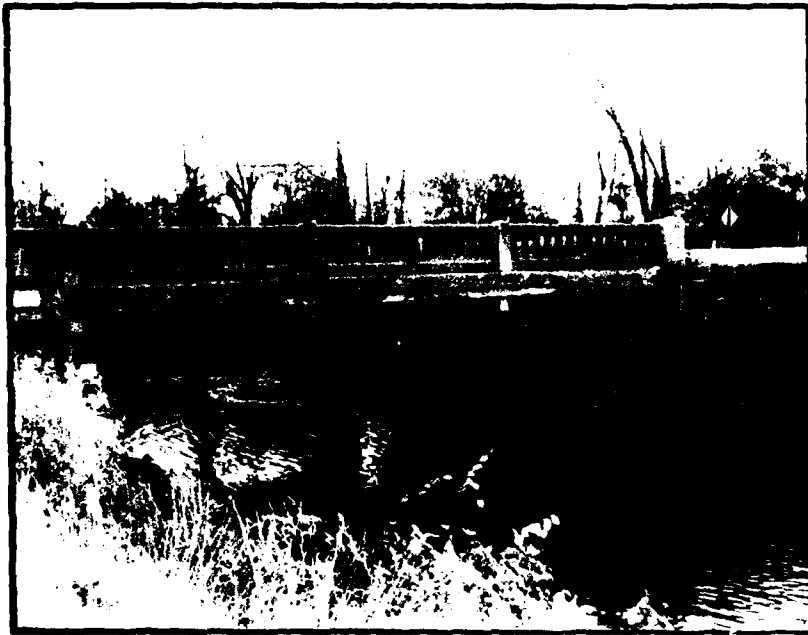


Figure 16 Upstream face of West Main Street bridge,
stream mile 1.60.



Figure 17 Upstream face of Powder Mill Road
bridge, stream mile 3.00.

Typical Bridges on Breakneck Creek
Photographs taken in November 1971



Figure 18 Looking upstream at Dam located at stream mile 54.96. West Main Street is in the background. Photograph taken in November 1971.



Figure 19 Looking upstream at Lake Rockwell Dam at stream mile 58.10. Photograph taken in February 1972.

Dams on the Cuyahoga River

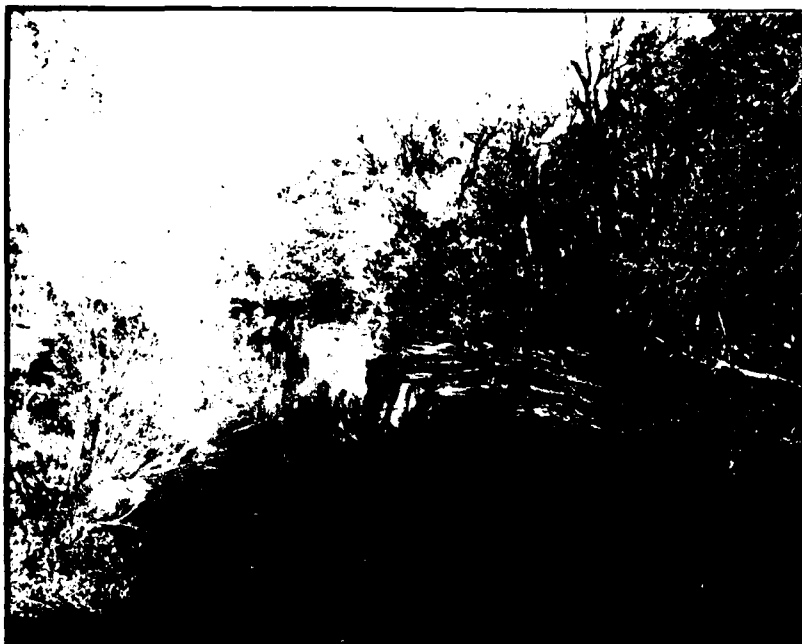


Figure 20 Looking upstream from Fuller Park Road bridge at channel obstruction. Stream mile 54.45.



Figure 21 Looking upstream from Stow Street bridge at channel obstruction. Stream mile 54.75.

Cuyahoga River
Obstructions to flood flows
Photographs taken in November 1971

FLOOD SITUATION

FLOOD STAGES AND DISCHARGES - Table 4 lists flood crests and peak discharges for the known floods exceeding bankfull stage of 2.84 feet at the Hiram Rapids gage and 9.00 feet at the Old Portage gage. A discharge of approximately 450 cfs will produce a stage of 2.84 feet at the Hiram Rapids gage and a discharge of approximately 3,500 cfs will produce a stage of 9.00 feet at the Old Portage gage.

Tables 5 and 6 list the ten highest discharges recorded at the Hiram Rapids gage and the Old Portage gage in order of magnitude. Plate 2 shows known crest stages and years of occurrence of floods since 1927 which have exceeded the bankfull stage of 2.84 feet at the Hiram Rapids gage. Plate 3 shows known crest stages and years of occurrence of floods since 1913 which have exceeded the bankfull stage of 9.00 feet at the Old Portage gage.

TABLE 4

KNOWN FLOODS AT HIRAM RAPIDS, OHIO

The table includes all known floods above bankfull stage of 2.84 feet at the U. S. Geological Survey station just downstream from the highway bridge at Winchell Road, Hiram Rapids, Ohio, stream mile 75.80. Drainage area = 151 square miles. Zero of gage = 1087.46 feet U.S.C. & G.S. datum (unadjusted). Top of bank at the gage site is at 1090.30 feet.

Gage Heights

Date of Crest	: Stage : feet (1)	: Discharge : c.f.s.	: Elevation : feet (1)
15 December 1927	: 5.30	: 1,630	: 1092.76
20 January 1929	: 6.26	: 2,260	: 1093.72
14 January 1930	: 5.43	: 1,710	: 1092.89
5 April 1931	: 3.40	: 689	: 1090.86
25 March 1932	: 3.61	: 795	: 1091.07
16 March 1933	: 4.84	: 1,360	: 1092.30
7 March 1934	: 5.27	: 1,620	: 1092.73
17 March 1935	: 4.13	: 1,000 (2)	: 1091.59
24 February 1945	: 5.06	: 1,480	: 1092.52
8 January 1946	: 4.27	: 1,060	: 1091.73
3 April 1947	: 5.40	: 1,690	: 1092.86
23 March 1948	: (2) 6.94	: 2,760	: 1094.40
29 January 1949	: 3.61	: 790	: 1091.07
15 February 1950	: 6.13	: 2,170	: 1093.59
5 January 1951	: 5.85	: 1,980	: 1093.31
27 January 1952	: 6.44	: 2,380	: 1093.90
21 January 1953	: 2.95	: 474	: 1090.41
27 March 1954	: 4.65	: 1,260	: 1092.11
17 March 1954	: 5.85	: 1,980	: 1093.31
9 March 1956	: 5.66	: 1,860	: 1093.12
26 April 1957	: 6.13	: 2,170	: 1093.59
1 March 1958	: 4.77	: 1,320	: 1092.23
23 January 1959	: 8.11	: 3,670	: 1095.57
31 March 1960	: 6.58	: 2,490	: 1094.04
26 April 1961	: 5.82	: 1,950	: 1093.28
24 March 1962	: 3.45	: 710	: 1090.91
19 March 1962	: 6.83	: 2,670	: 1094.29
6 March 1964	: 6.57	: 2,480	: 1094.03

TABLE 4 (Cont'd)

Gage Heights

Date of Crest	Stage feet (1)	Discharge c.f.s.	Elevation feet (1)
28 January 1965	5.05	1,470	1092.51
13 February 1966	5.62	1,820	1093.08
13 May 1967	4.30	1,080	1091.76
3 February 1968	5.71	1,880	1093.17
30 December 1969	6.07	2,130	1093.53
6 March 1970	4.43	1,140	1091.89

KNOWN FLOODS, CUYAHOGA RIVER AT OLD PORTAGE, OHIO

The table includes all known floods above bankfull stage of 9.0 feet at the U. S. Geological Survey gaging station just upstream of the Akron-Peninsula Road bridge which is about 4 miles northwest of Akron. Drainage area = 404 square miles. Zero of gage = 740.11 feet above mean sea level, unadjusted (USC & GS Datum)

Gage Heights

Date of Crest	Stage feet (1)	Discharge c.f.s.	Elevation feet (1)
March 1913	12.0 (2)	752.11 (2)	7,600 (2)
28 June 1924	10.0	750.11	4,450
5 April 1929	9.3	749.41	3,820
14 March 1933	9.1	749.21	3,560
26 January 1952	10.1	750.21	4,540
16 November 1955	10.1	750.21	4,540
8 July 1957	9.5	749.61	4,000
21 January 1959	11.5	751.61	6,500
10 February 1959	10.75	750.86	5,300
10 March 1964	9.35	749.46	3,850

(1) Based on existing stage-discharge relationship.

(2) Estimated by U. S. Army Corps of Engineers.

TABLE 5
HIGHEST TEN KNOWN FLOODS IN ORDER OF MAGNITUDE
CUYAHOGA RIVER AT U.S.G.S. GAGING STATION
HIRAM RAPIDS, OHIO

Order No.	Date of Crest	Stage feet (1)	Elevation feet (1)	Estimated Peak Discharge c.f.s.
1	23 January 1959	8.11	1095.57	3,670
2	23 March 1948	6.94	1094.40	2,760
3	19 March 1962	6.83	1094.29	2,670
4	31 March 1960	6.58	1094.04	2,490
5	6 March 1964	6.57	1094.03	2,480
6	27 January 1952	6.44	1093.90	2,380
7	20 January 1929	6.26	1093.72	2,260
8	15 February 1950	6.13	1093.59	2,170
9	26 April 1957	6.13	1093.59	2,170
10	30 December 1969	6.07	1093.53	2,130

(1) Based on existing stage-discharge relationship.

TABLE 6
HIGHEST TEN KNOWN FLOODS IN ORDER OF MAGNITUDE
CUYAHOGA RIVER AT U.S.G.S. GAGING STATION
OLD PORTAGE, OHIO

Order No.	Date of Crest	Stage feet (1)	Elevation feet (1)	Estimated Peak Discharge c.f.s.
1	March 1913	12.0 (2)	752.11 (2)	7,600 (2)
2	21 January 1959	11.5	751.61	6,500
3	10 February 1959	10.75	750.86	5,300
4	26 January 1952	10.1	750.21	4,540
5	16 November 1955	10.1	750.21	4,540
6	28 June 1924	10.0	750.11	4,450
7	8 July 1957	9.5	749.61	4,000
8	10 March 1964	9.35	749.46	3,850
9	5 April 1929	9.3	749.41	3,820
10	14 March 1933	9.1	749.21	3,560

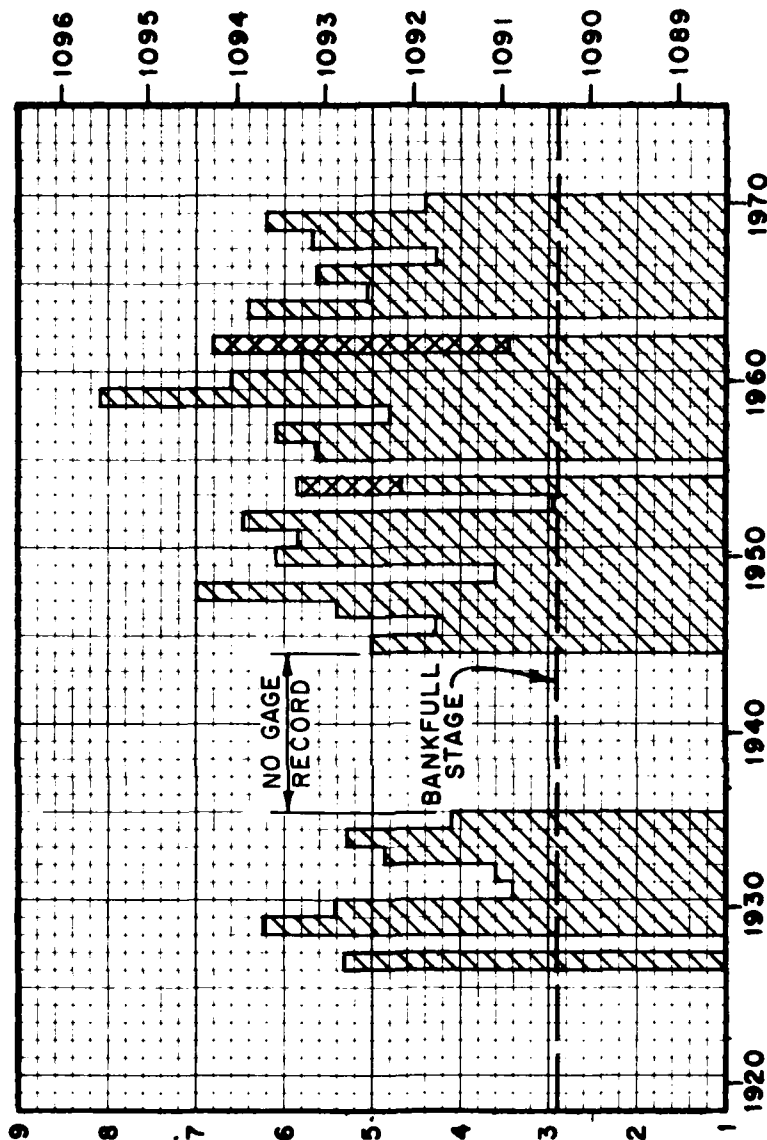
(1) Based on existing stage-discharge relationship.

(2) Estimated by U. S. Army Corps of Engineers.

DURATION AND RATE OF RISE - Plates 4 and 5 show the stage hydrographs of the January 1959 flood at the U.S.G.S. gaging stations on the Cuyahoga River at Hiram Rapids and at Old Portage. At the Hiram Rapids gage site during this flood the river rose to its crest in 52 hours at an average rate of rise of 0.1 foot per hour with a maximum rate of .25 foot in an hour and remained above bankfull (flood) stage for about 216 hours, or nine days. At the Old Portage gage site the river rose to its crest in 13 hours at an average rate of 0.4 foot per hour with a maximum rate of 1 foot in an hour and remained above bankfull (flood) stage for about 70 hours.

FLOODED AREAS, FLOOD PROFILES AND CROSS SECTIONS - Plates 7 and 8 show the approximate areas along the Cuyahoga River that would be inundated by the Intermediate Regional and the Standard Project Floods. The approximate elevations of these floods are shown on plates 9 and 10. Typical valley cross sections in the study area are shown on plate 11.

ELEVATION IN FEET - U. S. C. & G. S. DATUM



YEARS

CUYAHOGA RIVER AT HIRAM RAPIDS, OHIO
Stream gage at mile 75.80 Drainage Area, 151 Sq. Mi.
Zero of gage, Elevation 1087.46 U.S.C. & G.S. Datum.

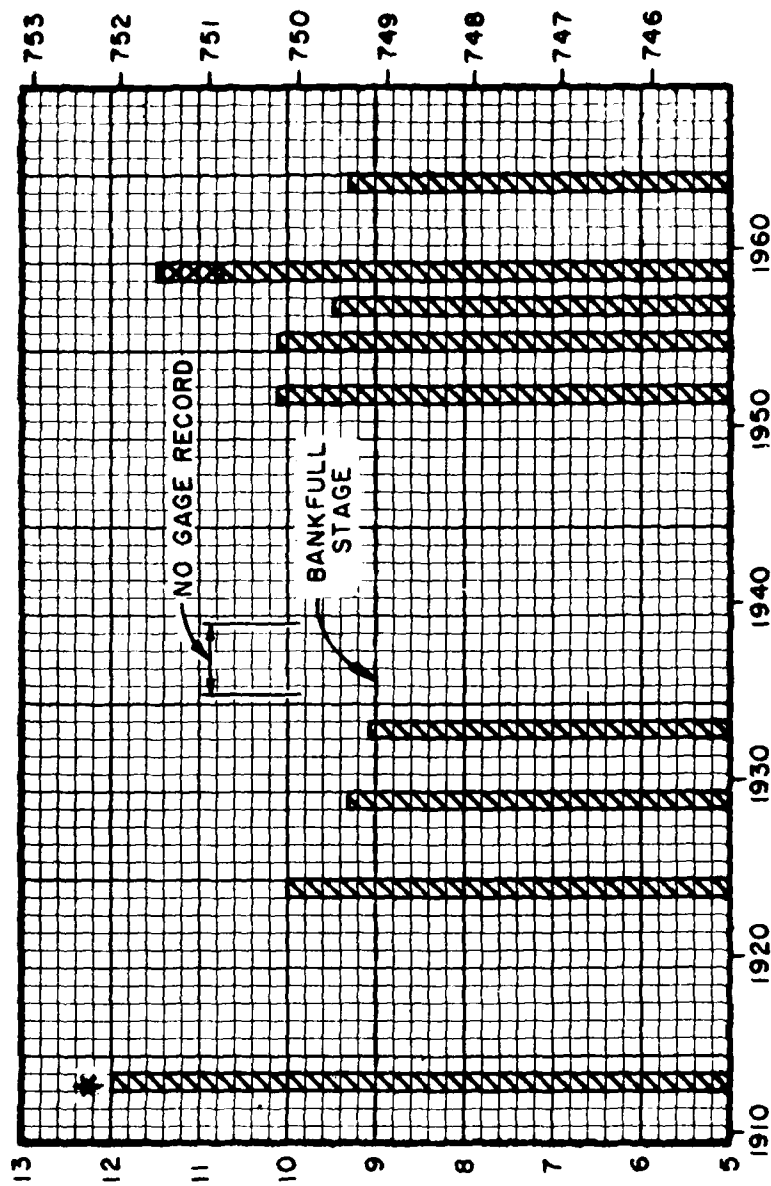
GAGE HEIGHT IN FEET
AT HIRAM RAPIDS, OHIO

NOTE:

Variation in shading on the bar graph indicates more than one flood during the year.

CUYAHOGA RIVER
CITY OF KENT AND
FRANKLIN TOWNSHIP, OHIO
FLOOD PLAIN INFORMATION REPORT
FLOODS ABOVE
BANKFULL STAGE
U. S. ARMY ENGINEER DISTRICT, BUFFALO
MAY 1972

ELEVATION IN FEET - U.S.C. & G.S. DATUM



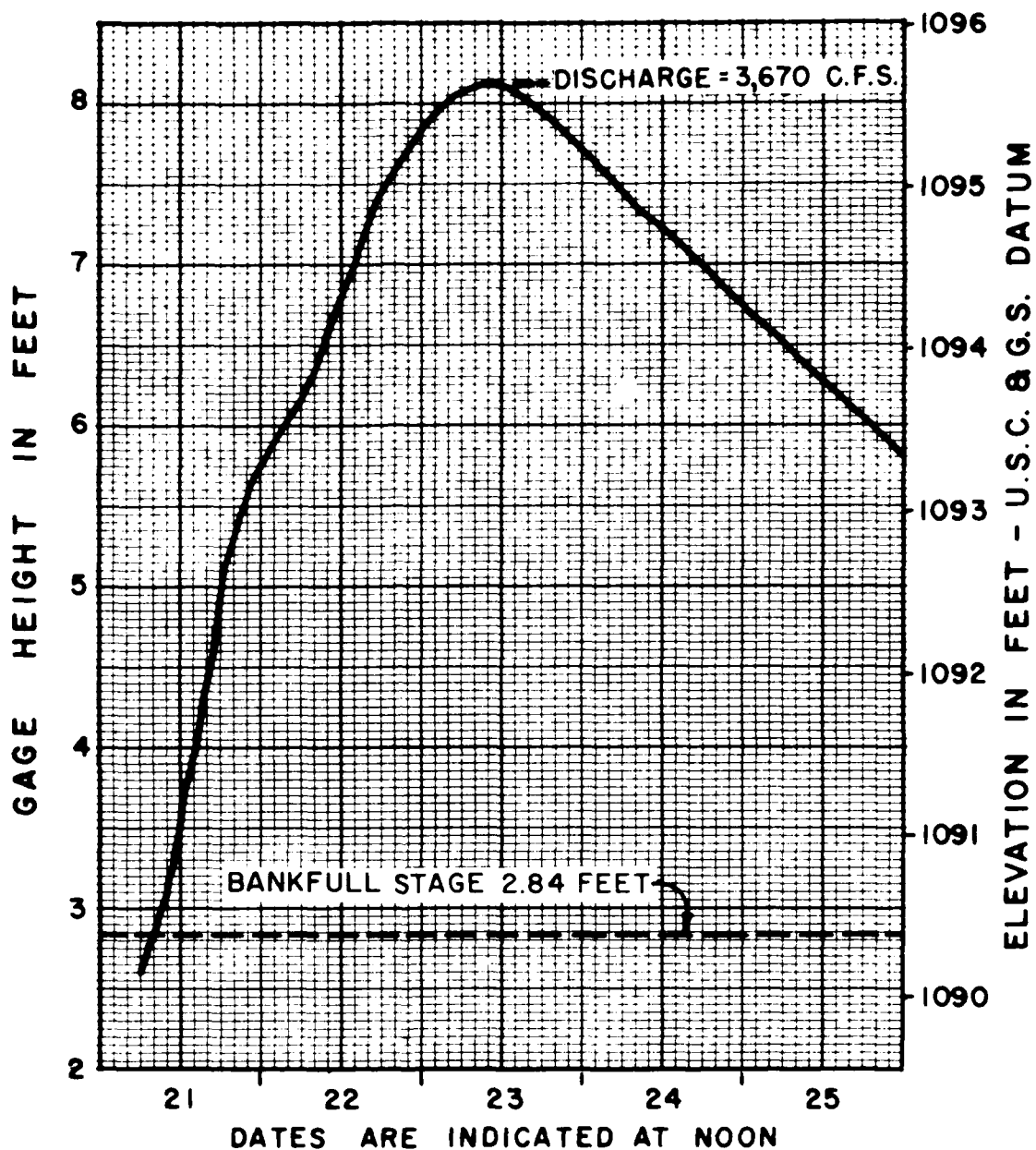
CUYAHOGA RIVER AT OLD PORTAGE, OHIO
Stream gage at mile 40.27 Drainage Area, 404 Sq. Mi.
Zero of gage, Elevation 740.11 U.S.C. & G.S. Datum

GAGE HEIGHT IN FEET
AT OLD PORTAGE, OHIO

NOTE:

* Indicates flood estimated by
U.S. Army, Corps of Engineers.
Variation in shading on the bar
graph indicates more than one
flood during the year.

CUYAHOGA RIVER
CITY OF KENT AND
FRANKLIN TOWNSHIP, OHIO
FLOOD PLAIN INFORMATION REPORT
**FLOODS ABOVE
BANKFULL STAGE**
U. S. ARMY ENGINEER DISTRICT, BUFFALO
MAY 1972



NOTES:

GAGE IS A WATER-STAGE RECORDER AND IS LOCATED AT STREAM MILE 75.0. THE ZERO OF THE GAGE EQUALS ELEVATION 1087.46 U.S.C. & G.S. DATUM (UNADJUSTED).

DRAINAGE AREA EQUALS 151 SQUARE MILES.

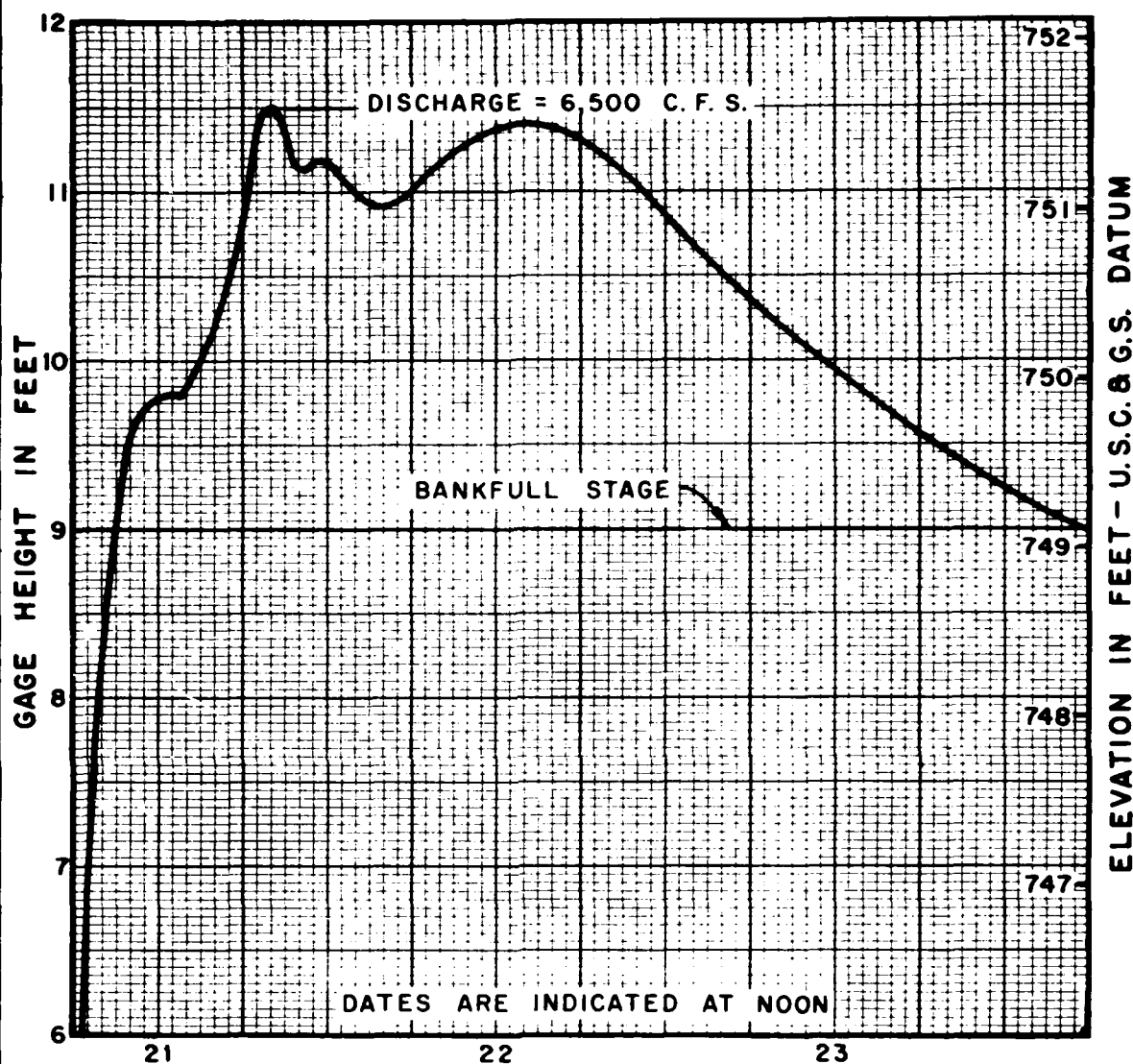
STAGES AFFECTED BY ICE FROM JAN. 16 TO 22 AND JAN. 28 TO FEB. 11, 1959. GAGE WELL WAS FROZEN FROM JAN. 24 TO 27, 1959. RECORD FOR THIS PERIOD BASED ON ONCE DAILY WIRE-WEIGHT GAGE READING.

BANKFULL STAGES DOES NOT NECESSARILY INDICATE INITIAL DAMAGING CONDITIONS.

CUYAHOGA RIVER
CITY OF KENT AND
FRANKLIN TOWNSHIP, OHIO
FLOOD PLAIN INFORMATION REPORT

STAGE HYDROGRAPH

U. S. ARMY ENGINEER DISTRICT, BUFFALO
MAY 1972



NOTES:

Old Portage automatic recording gage
at stream mile 40.27
Zero of Gage = 740.11 U.S.C. & G.S.
Bankfull stage = 9 ft. or El. 749.11
Drainage Area = 404 Sq. Mi.

CUYAHOGA RIVER
CITY OF KENT AND
FRANKLIN TOWNSHIP, OHIO
FLOOD PLAIN INFORMATION REPORT
STAGE HYDROGRAPH
U.S. ARMY ENGINEER DISTRICT, BUFFALO
MAY 1972

FLOOD DESCRIPTIONS

Descriptions of storms that have caused flooding in the Cuyahoga River basin are based upon field investigations, historical records and newspaper accounts. The greatest flood of historical record occurred in March 1913. A condensation of available information on these flood occurrences is given in the following paragraphs. This information is presented as an example of the type and extent of flood problems which have already occurred in the basin and an indication of possible future flood problems.

23-26 MARCH 1913 - The storm which caused the greatest flood of historical record in the Cuyahoga River basin developed from the stagnation of a tropical marine air mass from the Gulf of Mexico against a cold air mass from Canada. Heavy rains occurred during the periods 13-15 and 20-21 March. These rains were only preliminary to a severe storm which developed during the period of 23-26 March. This storm extended from Texas to Lake Erie with its center over Bellefontaine, Ohio, 125 miles southwest of the Cuyahoga basin. Two low-pressure centers continued to form a long trough of low pressure which caused excessive rainfall in Ohio and neighboring states for about 60 hours. A record total of 11.16 inches of rainfall fell in Bellefontaine in 92 hours. Along the northeast edge of the storm the Cuyahoga basin received an average of 9.65 inches of rainfall in a 96-hour period. On 23 March, 1.85 inches fell; on 24 March, 4.75 inches fell; on 25 March, 1.89 inches fell; on 26 March, 1.16 inches fell. Because of four days of rain, the Cuyahoga River overtopped its banks and brought death and disaster to much of the valley. Big Reservoir in the Portage Lakes district gave way with millions of gallons of water pouring down the Ohio Canal. The Cuyahoga River was transformed into a rage sweeping everything before it.

In Kent, a dam and a section of railroad tracks were washed out causing heavy damage and preventing travel by rail for about a week.

25-26 JANUARY 1952 - Heavy rain occurred on 25-26 January 1952 over most of Ohio and caused many rivers to go on a rampage. At the Akron-Canton Airport Weather Station, 2.00 inches of rain fell in a 30-hour period over these two days. The maximum rainfall was 0.59 inch in a 3-hour period on 26 January. The severe storm on the 25th and 26th gave record breaking 24-hour precipitation measurements in many areas of Ohio. This storm produced the fourth and sixth highest stages ever recorded at the Old Portage and the Hiram Rapids gages, respectively.

20-21 JANUARY 1959 - A storm developed from a large mass of cold air over northwestern Canada, a flow of warmer air from the southwest and the associated frontal system. Heavy rains began when the moisture-laden air from the south and the cold front converged. The storm was centered approximately 150 miles southwest of the Cuyahoga River basin. High water caused by two days of rain on 20-21 January 1959 inflicted damage in not only parts of Portage County but throughout the State of Ohio. More rain than usually falls in the whole month of January was dumped on the Akron area on these two days causing widespread damage to homes and highways. Some families were forced to evacuate their homes by boat. During January 1959 temperatures were several degrees below normal. When the temperatures reached -5° on the 18th, the ground became frozen. At the Akron Sewage Works, 2.86 inches of rain fell during a 30-hour period on 20-21 January. In a 3-hour period on 21 January, 0.82 inch of rain fell. Although total rainfall for the storm was not excessive, intensities were high and runoff was increased by the frozen ground and the 6-inch snow cover on the basin. Following the rainfall, there was a warming trend which contributed snow melt. Rainfall averaged 2.34 inches over the entire basin; runoff from rainfall and snow melt averaged 2.94 inches. At the Hiram Rapids gage the January 1959 flood reached elevation 1095.57, U.S.C. & G.S. datum, which is approximately 5.3 feet above bankfull stage. At the Old Portage gage the January 1959 flood reached elevation 751.61, U.S.C. & G.S. datum, which is approximately 2.5 feet above bankfull stage.

This concludes the "General Conditions and Past Floods" section of this report. What can be done to prevent and/or reduce future flood

damages? FLOOD PLAIN MANAGEMENT provides the solution! Wise flood plain management can control the use of the flood plain as a means of reducing damage caused by future flooding.

By using the flooded area maps, profiles and cross sections contained in this report as a guide, limited urban development can be allowed in the flood plain depending on the frequency of flooding. The elevations shown on the profiles should be used to determine flood heights because they are more accurate than the flooded outlines. Units of low damage construction should be stressed during future development in areas which are susceptible to frequent flooding. If it is uneconomical to elevate these lands, a means of flood proofing the structures should be given careful consideration.

As soon as possible, local governments should develop and enforce flood plain regulations based on the information contained in this report. This report provides local governments with the necessary tools to control the extent and type of development which would be allowed to take place within the flood plain. Regulation of the flood plain can usually be carried out most effectively by a combination of the several regulatory methods ... zoning ordinances, subdivision regulations and building codes. Local governments can also police and maintain the floodway so as to insure against the overgrowth of brush, weeds, debris and large trees which obstruct flood flows. All of these factors result in increased river stages. The U. S. Army Corps of Engineers has prepared and is distributing to State, county and local governments for public dissemination two pamphlets, "Guidelines for Reducing Flood Damages" and "Introduction to Flood Proofing." The combination of data presented in this report and in the pamphlets will provide general guidelines for flood damage reduction in future development within the Cuyahoga River flood plain. Figure 22 lists the corrective and preventive measures described in the above mentioned pamphlets. The U. S. Army Corps of Engineers will distribute to State, county and local governments other helpful pamphlets as well as additions to existing pamphlets when they are developed. Figures 23 and 24 indicate the desired development of a flood plain.

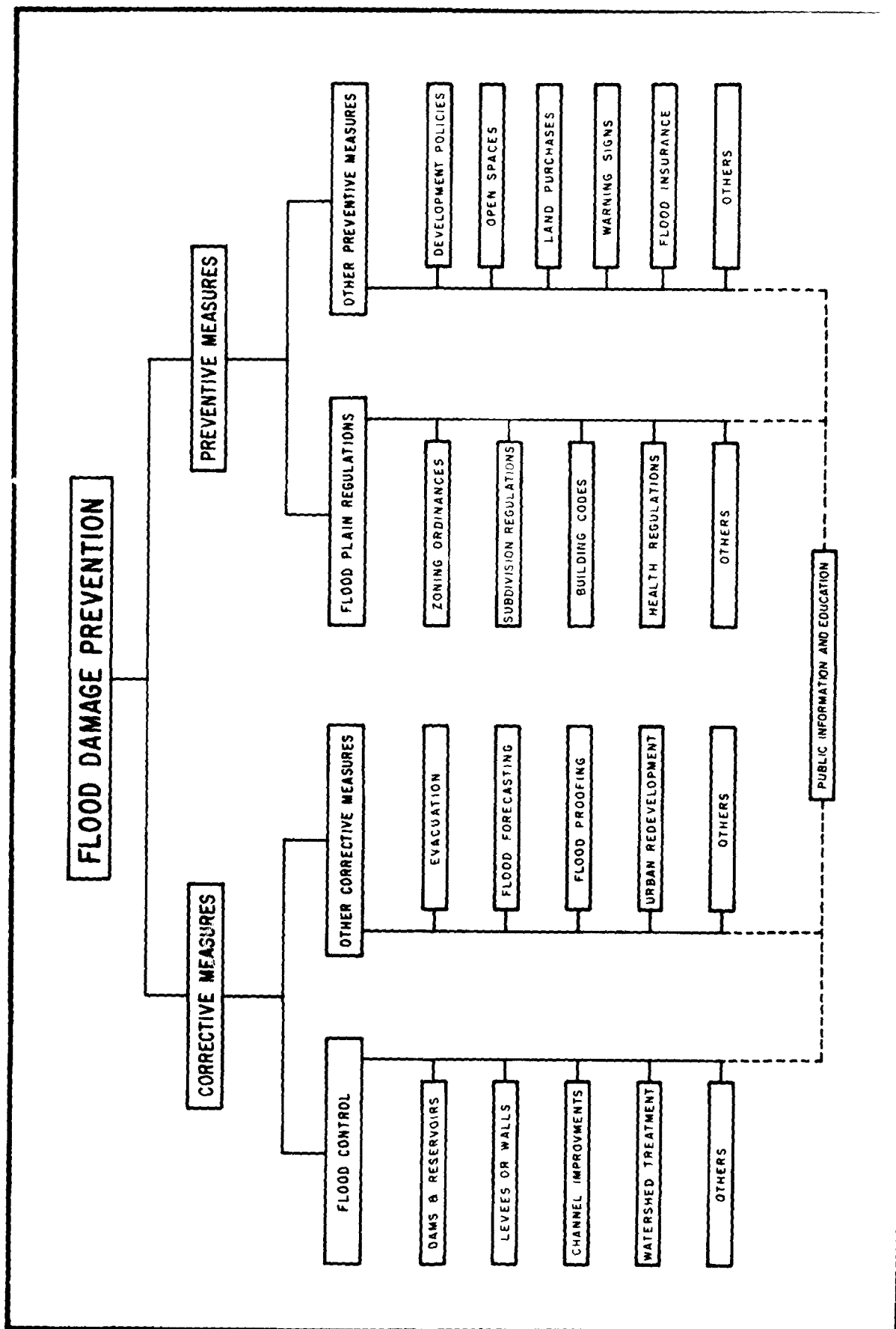


FIGURE 22



Figure 23 Low damage development which is compatible with wise flood plain useage. Arrow indicates the height of the Standard Project Flood Stream mile 54.58. Photograph taken in November 1971.



Figure 24 House, bordering Breakneck Creek at stream mile 3.05, built up to be well out of the range of the Intermediate Regional Flood or the Standard Project Flood. Photographs taken in February 1972.

Wise flood plain use

FUTURE FLOODS

In order to determine future floods, it is desirable to study past floods on other streams in the same general region. Table 7 lists the maximum known floods at various U.S.G.S. gaging stations.

This section of the report discusses two possible future floods: the Intermediate Regional and the Standard Project Floods on the Cuyahoga River.

The Standard Project Flood is a severe flood of infrequent occurrence. It is possible, but unlikely, that a flood of greater magnitude could occur. The Standard Project Flood concept developed by the U. S. Army Corps of Engineers provides an indication of the upper limit of flooding in a particular area and is used to compare floods in different locations throughout the United States.

The Intermediate Regional Flood may reasonably be expected to occur more frequently than the Standard Project Flood. To avoid possible damage from floods of Intermediate Regional or Standard Project magnitude, flood plains should not be developed without consideration to possible future flood elevations, the risks involved, and possible alternatives.

TABLE 7
MAXIMUM KNOWN FLOODS DISCHARGES AT U.S.G.S. GAGING STATIONS IN THE REGION OF CUYAHOGA RIVER, OHIO

Stream	Location Ohio	Period of Record (years)	Drainage Area (sq. mi.)	Peak discharge of record		Estimated Recurrence Interval (years*)
				Date	Amount (cfs)	per sq. mi.
Cuyahoga River	Hiram Rapids	34	151	23 Jan. 1959	3,670	24.3
Cuyahoga River	Independence (1)	36	707	22 Jan. 1959	21,000	29.7
Cuyahoga River	Old Portage	41	405	21 Jan. 1959	6,500	16.1
Sandusky River	Fremont (2)	40	1,251	10 Feb. 1959	28,000	22.4
Huron River	Milan	16	371	4 Jul. 1969	57,000(3)	153.6
Vermilion River	Vermilion	16	262	5 Jul. 1969	45,000(3)	171.7
Black River	Elyria	22	396	4 Jul. 1969	33,500(3)	84.6
Rocky River	Berea	35	267	22 Jan. 1959	21,400	80.1
Chagrin River	Willoughby	37	246	22 Mar. 1948	28,000	113.8
Grand River	Madison	41	581	22 Jan. 1959	21,100	36.3
Ashtabula River	Ashtabula	35	121	22 Jan. 1959	11,600	95.9
Conneaut Creek	Conneaut	29	175	22 Jan. 1959	17,000	97.1

* Based on conditions of development at time of flood.

- (1) The estimated peak discharge of the maximum historic flood was 30,000 cfs for the 1913 flood. It has a recurrence interval on the order of once in 200 years.
- (2) The estimated peak discharge of the maximum historic flood was 63,500 cfs for the 1913 flood. It has an exceedance interval of about 500 years based on a discharge-frequency basis and about 200 years on a stage-frequency basis.
- (3) Provisional.

DETERMINATION OF INTERMEDIATE REGIONAL FLOOD

The Intermediate Regional Flood is defined as a flood having a recurrence interval of once in 100 years at a designated location. However, this flood may occur in any one year or in consecutive years. A statistical analysis of stream flow records available for the basin under study is often used to determine a frequency of occurrence, but limitations in such records usually require analysis of rainfall and runoff characteristics in the "general region" of the area. Although the Intermediate Regional Flood represents a major flood, it is much less severe than the Standard Project Flood.

Results of the studies indicate that the Intermediate Regional Flood on Cuyahoga River at the Old Portage and Hiram Rapids gaging stations would have a peak discharge of 5,820 and 4,900 cfs, respectively. Prorating discharge using the drainage area ratios, it was determined that a peak discharge of 5,300 cfs at the upstream end and 5,200 cfs at the downstream end of the Cuyahoga River in the study area would occur. A peak discharge of 2,200 cfs would occur on Breakneck Creek.

DETERMINATION OF STANDARD PROJECT FLOOD

Only in rare instances has a specific stream experienced the largest flood than can be expected to occur. It is a commonly accepted fact that sooner or later a larger flood can and probably will surpass the maximum known flood on a given stream. The Corps of Engineers, in cooperation with the National Weather Service, has made broad and comprehensive studies and investigations based on the records of past storms and floods and has evolved generalized procedures for estimating the flood potential of streams. These procedures have been used in determining the Standard Project Flood. The Standard Project Flood is defined as the flood that can be expected from the most severe combination of meteorological and hydrological conditions that is considered reasonably characteristic of the geographical region involved. Although the Standard Project Flood has only a rare chance of occurrence, it is

not the most severe flood that could occur. The Standard Project Storm rainfall used for the Cuyahoga River at the Hiram Rapids gage amounts to 10.34 inch for 24 hours, 12.04 inches for 48 hours, 13.43 inches for 72 hours, and a total of 14.02 inches in 96 hours. At the Old Portage gage the amounts were 0.32 inch for 24 hours, 1.73 inches for 48 hours, 8.44 inches for 72 hours, and a total of 8.99 inches in 96 hours. Rainfall of these magnitudes have recently been recorded in the region. In July 1969 in Wooster, Ohio 9.37 inches of rain fell in 24 hours, and a total of 10.69 inches fell in 96 hours. The peak discharge of the Standard Project Flood on Cuyahoga River at the U.S.G.S. gaging stations at Old Portage and Hiram Rapids is 41,100 cfs and 18,300 cfs, respectively. Prorating the discharge by using drainage area ratios it was determined that the peak discharge of the Standard Project Flood on the Cuyahoga River would be 32,500 cfs at the downstream end and 22,200 cfs at the upstream end of the study area. Breakneck Creek would have a peak discharge of 13,200 cfs. The Standard Project Flood discharge was based on the assumption that there would be no storage in the reservoirs in the upper basin of the Cuyahoga River.

FREQUENCY - It is not practical to assign a frequency to a Standard Project Flood. However, the flood could occur during any year.

POSSIBLE LARGER FLOODS - Floods larger than the Standard Project Flood are possible. However, the combination of factors that would be necessary to produce such floods seldom occur.

HAZARDS OF GREAT FLOODS

AREAS FLOODED AND HEIGHTS OF FLOODING - The areas along the Cuyahoga River inundated by the Standard Project and Intermediate Regional Floods are shown on plates 7 and 8. Depths of flow for the Standard Project Flood, and the Intermediate Regional Flood can be estimated from the valley sections which are shown on plate 11.

The Intermediate Regional and the Standard Project flood profiles were computed by using stream characteristics for selected reaches as determined from observed flood profiles, topographic maps and valley cross sections. The overflow areas shown on plates 7 and 8 and the water surface profiles shown on plates 9 and 10 have been determined with an accuracy consistent with the purpose of this study and the accuracy of the available basic data. The water surface profiles depend to a great extent upon the degree of destruction or clogging of various bridges during the flood occurrence. Because it is impossible to forecast these events, it was assumed that all bridge structures would stand and that no clogging would occur.

The approximate heights of the Standard Project Flood, and the Intermediate Regional Flood at selected sites are shown in figures 25 through 30.

VELOCITIES, RATES OF RISE AND DURATION OF FLOODING - Table 8 lists the average velocities that would occur in the channel and overbank areas during the Intermediate Regional and Standard Project Floods.

Rates of rise are dependent upon the development, rainfall intensity, slope of the basin and loss rate of rainfall. They can also depend upon the condition of the channel and amount of debris in the channel at the time of the storm. The duration of a flood above bank-full stage is dependent upon the duration of the storm and on the assumption that the storm was caused by rainfall and does not include

prolonged runoff from snow melt and high stages caused by ice jams, etc. Table 9 lists the total rise from low water to the crest, the maximum rate of rise, and the duration above bankfull stage of the Intermediate Regional and Standard Project Floods for the Cuyahoga River.

TABLE 8
AVERAGE VELOCITIES

Vicinity Location	Stream: Mile	Flood	*Average Velocities	
			Channel (ft. per sec.)	Overbank (ft. per sec.)
<u>Cuyahoga River</u>				
Middlebury Road	:52.80	:Intermediate Regional	: 10.0	: 3.0
		:Standard Project	: 11.0	: 3.8
Norfolk & Western Railroad Br.	:53.95	:Intermediate Regional	: 3.2	: 1.1
		:Standard Project	: 4.8	: 2.5
Crain Avenue	:55.35	:Intermediate Regional	: 5.0	: 0.2
		:Standard Project	: 11.5	: 4.0
Ravenna Road	:57.75	:Intermediate Regional	: 3.6	: 1.0
		:Standard Project	: 4.5	: 1.4
<u>Breakneck Creek</u>				
Brady Lake Road	: 0.45	:Intermediate Regional	: 4.0	: 1.2
		:Standard Project	: 4.7	: 1.7
East Main Street	: 1.60	:Intermediate Regional	: 2.7	: 1.2
		:Standard Project	: 4.1	: 1.8
Powder Mill Road	: 3.00	:Intermediate Regional	: 2.7	: 0.9
		:Standard Project	: 3.7	: 1.7

*Average velocity for selected location. Velocities could be greater in isolated areas, especially in overbank section. High channel and overbank velocities, in combination with deep, fairly long-duration flooding, would create a hazardous situation in the flood plain. When velocity (in feet per second) times depth (in feet) is greater than nine, hazardous conditions prevail.

TABLE 9
RATES OF RISE AND DURATIONS OF FLOODING
AT U.S.G.S. GAGE AT HIRAM RAPIDS
STREAM MILE 75.80

Flood	: Time of : rise : (hrs)	: Maximum rate : of rise : (ft/hr)	: Duration above : bankfull stage : (hrs)
Intermediate Regional	: 50	: 0.25	: 102
Standard Project	: 69	: 0.50	: 140

RATES OF RISE AND DURATIONS OF FLOODING
AT U.S.G.S. GAGE AT OLD PORTAGE
STREAM MILE 40.27

Flood	: Time of : rise : (hrs)	: Maximum rate : of rise : (ft/hr)	: Duration above : bankfull stage : (hrs)
Intermediate Regional	: 30	: 0.7	: 58
Standard Project	: 53	: 0.6	: 135

Since the study area is located between these two gages, these rates of rise and durations can be used to indicate the severity of flooding in the area.

These rates of rise should give adequate warning that a flood is coming. However, a clogged bridge or an ice jam could act as a dam and cause water to back up and form a pond. When sufficient head accumulates in the pond to break the jam, a surge of water would flow downstream causing an almost instantaneous rate of rise.



Figure 25 Arrows indicate the heights of the Intermediate Regional and the Standard Project floods at Sewage treatment plant, stream mile 54.0.



Figure 26 Arrows indicate the heights of the Intermediate Regional and the Standard Project floods at Sewage treatment plant, stream mile 54.0.

Cuyahoga River
Possible future flood heights
Photographs taken in November 1971

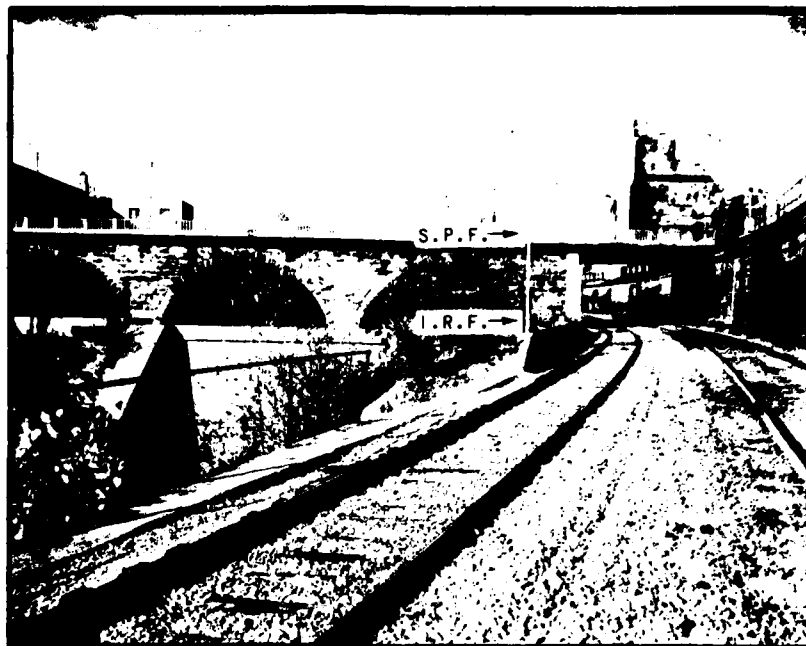


Figure 27 Arrows indicate the heights of the Intermediate Regional and the Standard Project floods just downstream of the West Main Street bridge, stream mile 55.0.



Figure 28 Arrows indicate the heights of the Intermediate Regional and the Standard Project floods at the Penn Central Transportation Co. railroad bridge, stream mile 57.75.

Cuyahoga River
Possible future flood heights
Photographs taken in November 1971



Figure 29 Arrows indicate the heights of the Intermediate Regional and the Standard Project floods at a car dealer on the downstream side of East Main Street bridge, stream mile 1.59. Photograph taken in January 1972.



Figure 30 Arrows indicate the heights of the Intermediate Regional and the Standard Project floods at the East Main Street bridge, stream mile 1.6. Photograph taken in November 1971.

Breakneck Creek
Possible future flood heights

GLOSSARY OF TERMS

Discharge. The quantity of flow in a stream at any given time, usually measured in cubic feet per second (cfs).

Flood. An overflow of lands not normally covered by water and that are used or usable by man. Floods have two essential characteristics: The inundation of land is temporary; and the land is adjacent to and inundated by overflow from a river or stream or an ocean, lake, or other body of standing water.

Normally a "flood" is considered as any temporary rise in stream flow or stage, but not the ponding of surface water, that results in significant adverse effects in the vicinity. Adverse effects may include damages from overflow of land areas, temporary backwater effects in sewers and local drainage channels, creation of unsanitary conditions or other unfavorable situations by deposition of materials in stream channels during flood recessions, rise of ground water coincident with increased stream flow, and other problems.

Flood Crest. The maximum stage or elevation reached by the waters of a flood at a given location.

Flood Peak. The maximum instantaneous discharge of a flood at a given location. It usually occurs at or near the time of the flood crest.

Flood Plain. The relatively flat area or low lands adjoining the channel of a river, stream or watercourse or ocean, lake, or other body of standing water, which has been or may be covered by flood water.

Flood Profile. A graph showing the relationship of water surface elevation to location, the latter generally expressed as distance above mouth, for a stream of water flowing in an open channel. It is generally drawn to show surface elevation for the crest of a specific flood, but may be prepared for conditions at a given time or stage.

Flood Stage. The stage or elevation at which overflow of the natural banks of a stream or body of water begins in the reach or area in which the elevation is measured.

Head Loss. The effect of obstructions, such as narrow bridge openings or buildings that limit the area through which water must flow, raising the surface of the water upstream from the obstruction.

Hydrograph. A curve denoting the discharge or stage of flow over a period of time.

Intermediate Regional Flood. A flood having an average frequency of occurrence in the order of once in 100 years although the flood may occur in any year. It is based on statistical analyses of streamflow records available for the watershed and analyses of rainfall and runoff characteristics in the "general region of the watershed."

Left Bank. The bank on the left side of a river, stream, or watercourse, looking downstream.

Low Steel (or Underclearance). See "underclearance."

Right Bank. The bank on the right side of a river, stream, or watercourse, looking downstream.

Standard Project Flood. The flood that may be expected from the most severe combination of meteorological and hydrological conditions that is considered reasonably characteristic of the geographical area in which the drainage basin is located, excluding extremely rare combinations. Peak discharges for these floods are generally about 40% to 60% of the Probable Maximum Floods for the same basins. Such floods, as used by the Corps of Engineers, are intended as practicable expressions of the degree of protection that should be sought in the design of flood control works, the failure of which might be disastrous.

Underclearance. The lowest point of a bridge or other structure over or across a river, stream, or watercourse that limits the opening through which water flows. This is referred to as "low steel" in some regions.

AUTHORITY, ACKNOWLEDGMENTS AND INTERPRETATION OF DATA

PUBLIC LAW - This report has been prepared in accordance with the authority granted by Section 206 of the Flood Control Act of 1960 (PL 86-465), as amended.

* * *

ACKNOWLEDGMENTS - The assistance and cooperation of the United States Geological Survey, National Weather Service, Ohio Department of Natural Resources, Tri-County Regional Planning Commission, various local governmental agencies in the study area, and private citizens in providing useful data are appreciated.

* * *

This report presents the local flood situation caused by the Cuyahoga River through the City of Kent and township of Franklin. The U. S. Army Engineer District, Buffalo, will provide interpretation and limited technical assistance in the application of the data contained in this report, particularly as to its use in developing effective flood plain regulations. Requests should be coordinated through the Ohio Department of Natural Resources, Division of Water. After local authorities have selected the flood magnitude or frequency to be used as the basis for regulation, the Corps of Engineers can assist in the selection of floodway limits by providing information on the effects of various widths of floodway on the profile of the selected flood.

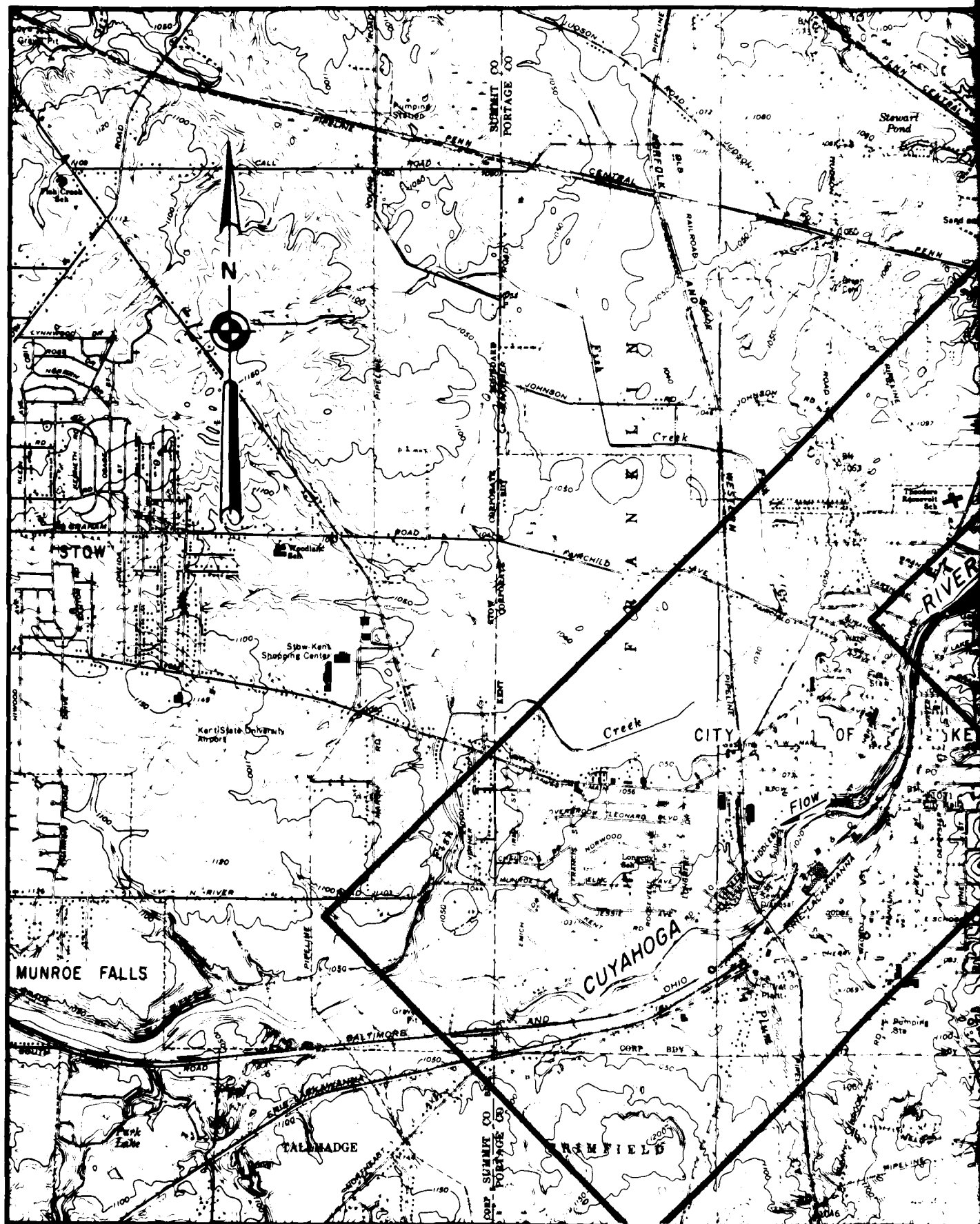
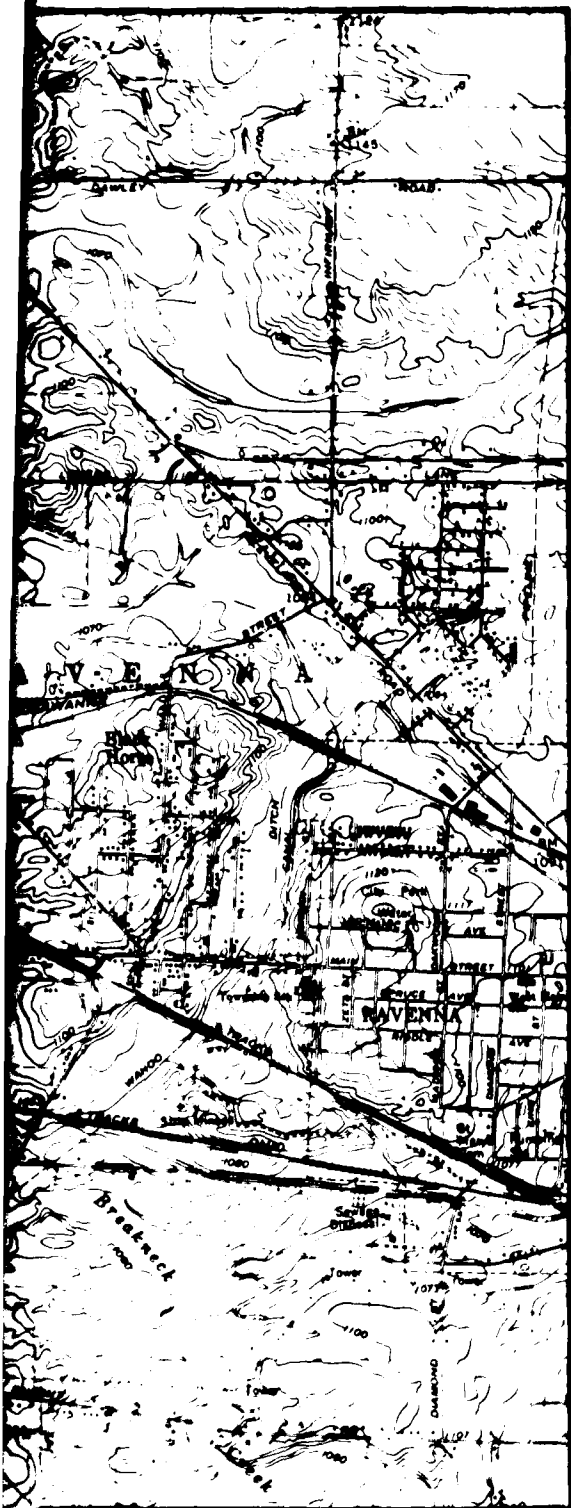




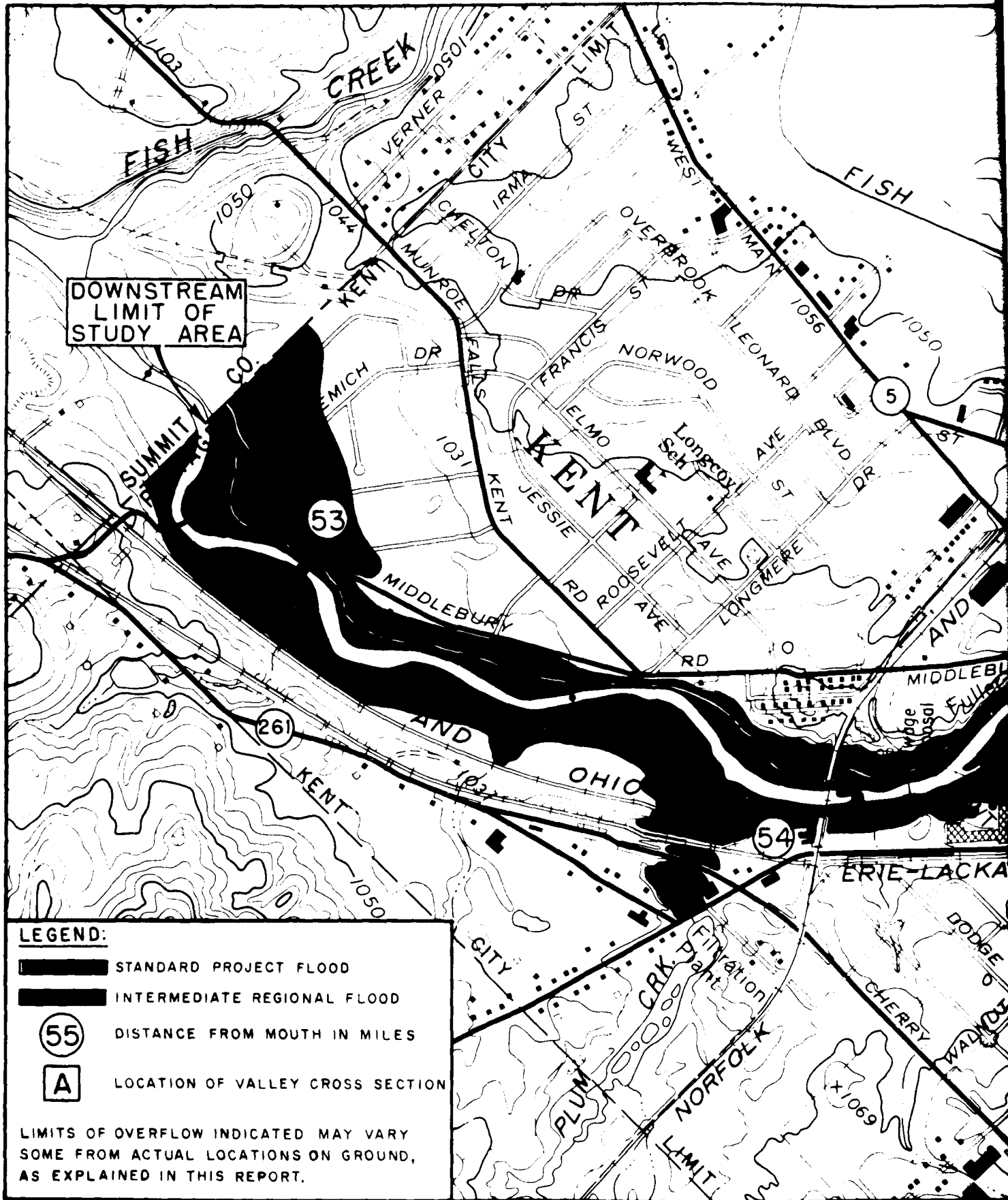
PLATE 8

SCALE IN MILES

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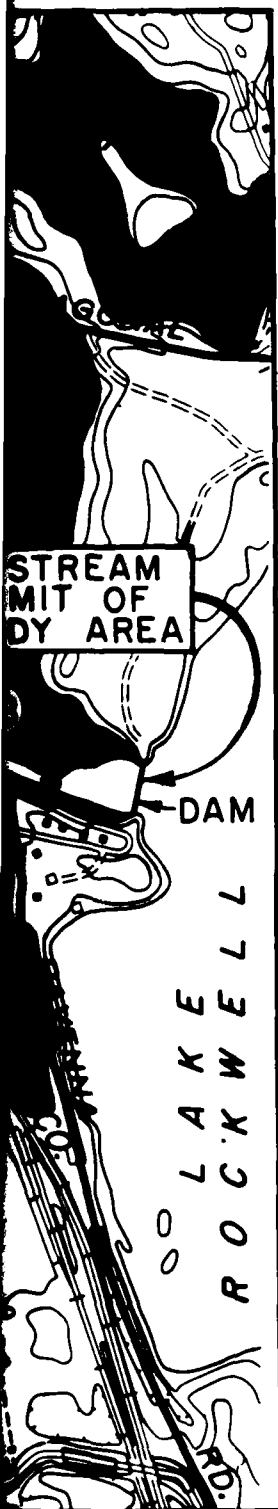


CUYAHOGA RIVER
CITY OF KENT AND
FRANKLIN TOWNSHIP, OHIO
FLOOD PLAIN INFORMATION REPORT
INDEX MAP
FOR FLOODED AREAS
U S ARMY ENGINEER DISTRICT, BUFFALO
MAY 1972









SA RIVER
KENT AND
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FORMATION REPORT
D AREAS
55 TO 58.10
R DISTRICT, BUFFALO
1972





STANDARD PROJECT FLOOD

INTERMEDIATE REGIONAL FLOOD

DISTANCE FROM MOUTH IN MILES

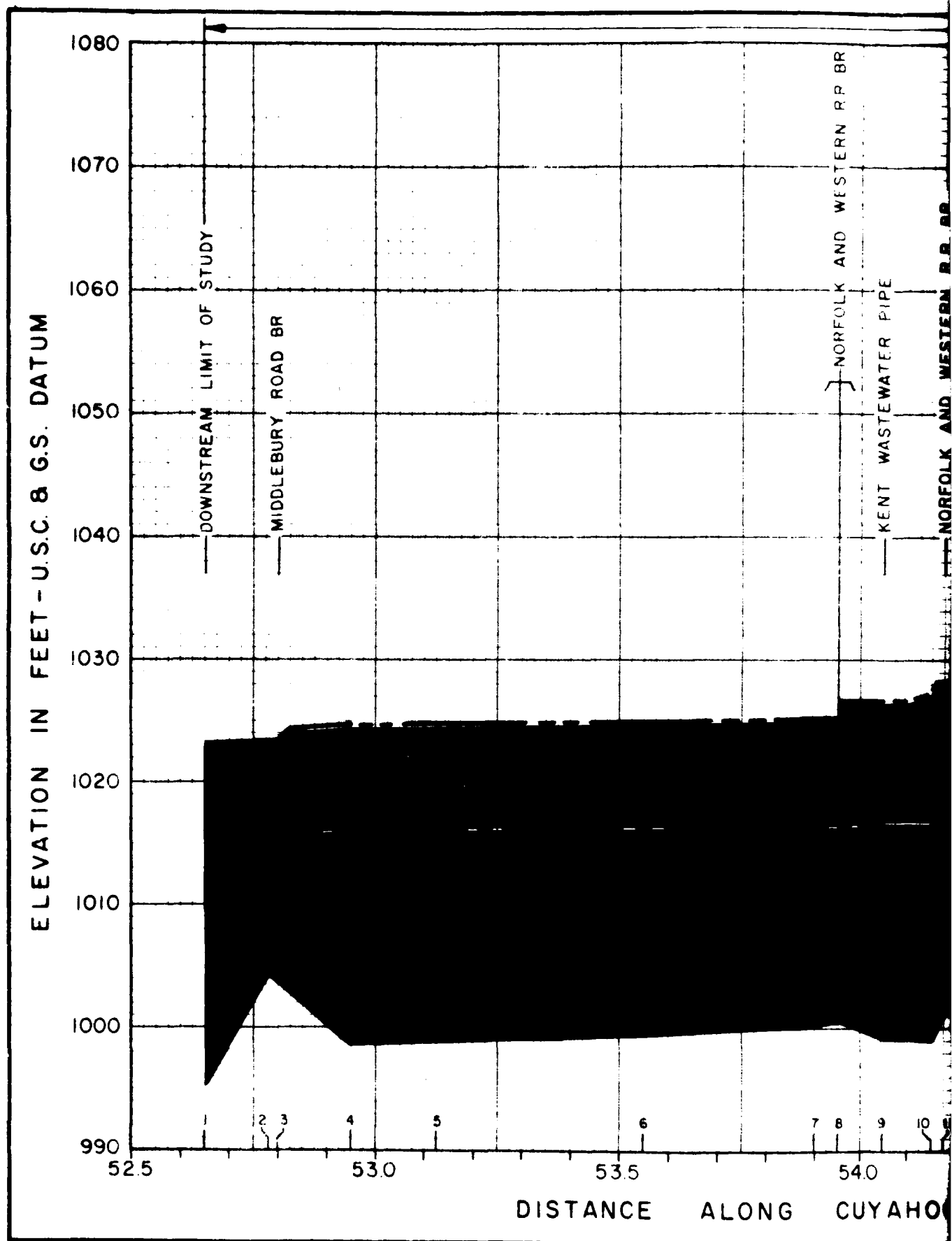
LOCATION OF VALLEY CROSS SECTION

IF OVERFLOW INDICATED MAY VARY SOME
ACTUAL LOCATIONS ON GROUND, AS EXPLAINED
REPORT.



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FLOOD PLAIN INFORMATION REPORT
FLOODED AREAS
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PLATE 8



CITY OF KENT

NORFOLK AND WESTERN RR BR.

KENT WASTEWATER PIPE

NORFOLK AND WESTERN R.R. BR.

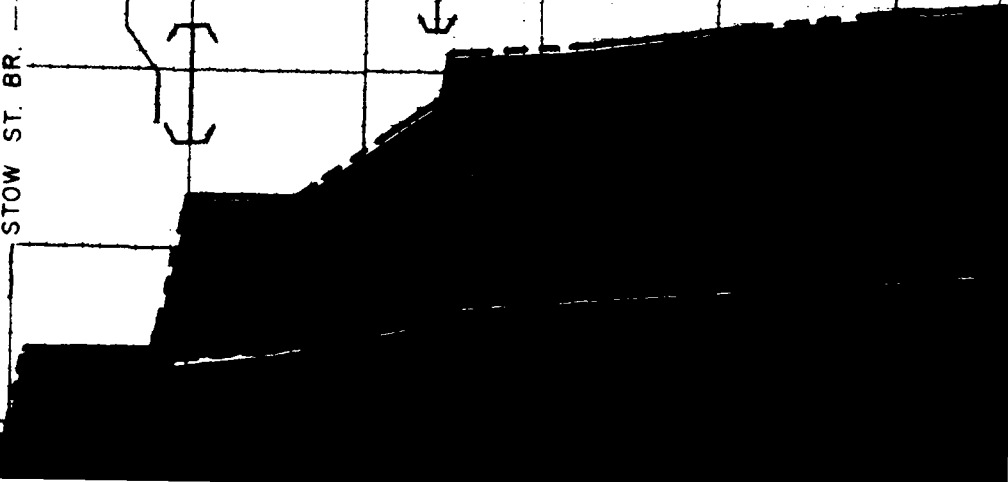
FULLER PARK ROAD BR.

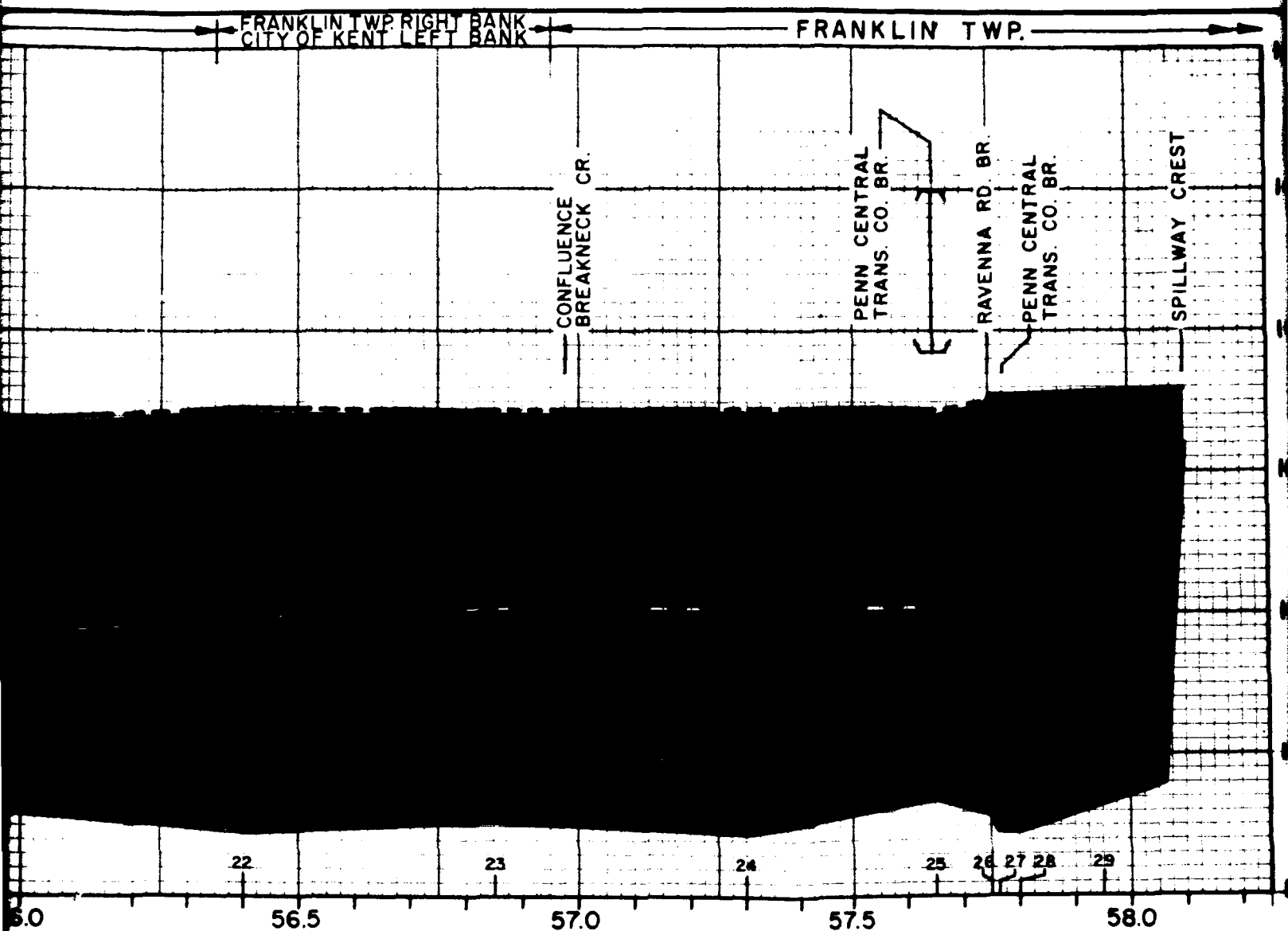
STOW ST. BR.

DAM

WEST MAIN ST. BR.

CRAIN AVE. BR.





NOTES:

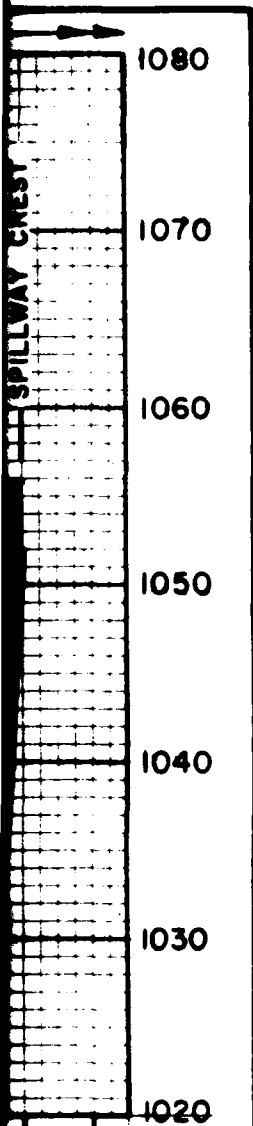
CREST PROFILES ARE BASED ON THE FOLLOWING:

1. EXISTING CHANNEL CONDITIONS
2. EXISTING STRUCTURES
3. EXISTING CONDITIONS OF DEVELOPMENT

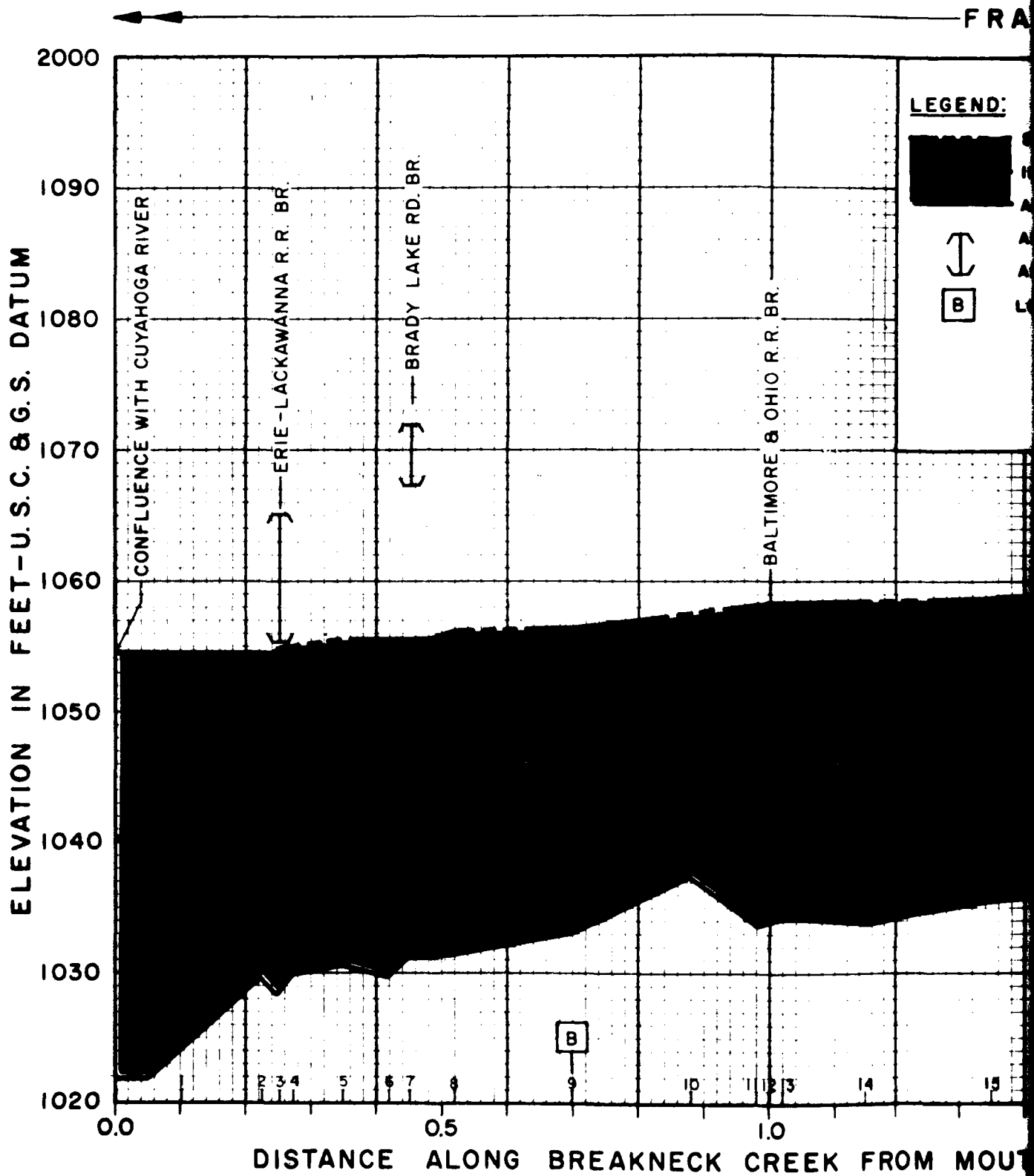
LARGE SCALE FILLING WILL RAISE PROFILES UNLESS SUFFICIENT FLOODWAY IS PROVIDED.

WARD PROJECT FLOOD
 MEDIAN REGIONAL FLOOD
 EXISTING STREAM BED
 EXISTING FLOOR ELEVATION
 EXISTING LOW STEEL ELEVATION
 SECTION OF VALLEY CROSS SECTION

**CUYAHOGA RIVER
 CITY OF KENT AND
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 U. S. ARMY ENGINEER DISTRICT,
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1972



FRANKLIN TOWNSHIP

LEGEND

STANDARD PROJECT FLOOD

INTERMEDIATE REGIONAL FLOOD

APPROXIMATE STREAM BED

APPROXIMATE FLOOR ELEVATION

APPROXIMATE LOW STEEL ELEVATION

LOCATION OF VALLEY CROSS SECTION



B

NOTES:

CREST PROFILES ARE BASED ON THE FOLLOWING:

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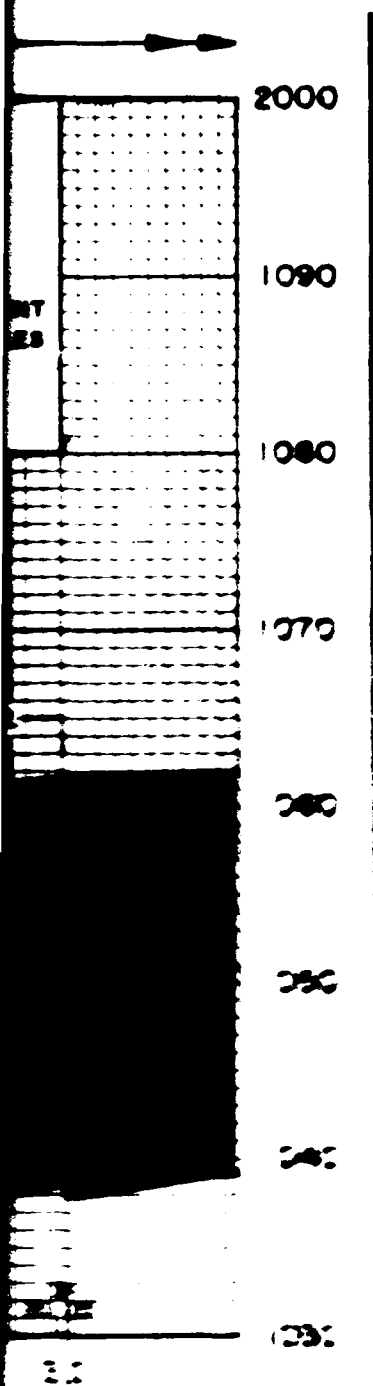
2. EXISTING STRUCTURES

3. EXISTING CONDITIONS OF DEVELOPMENT

LARGE SCALE FILLING WILL RAISE PROFILES UNLESS SUFFICIENT FLOODWAY IS PROVIDED.

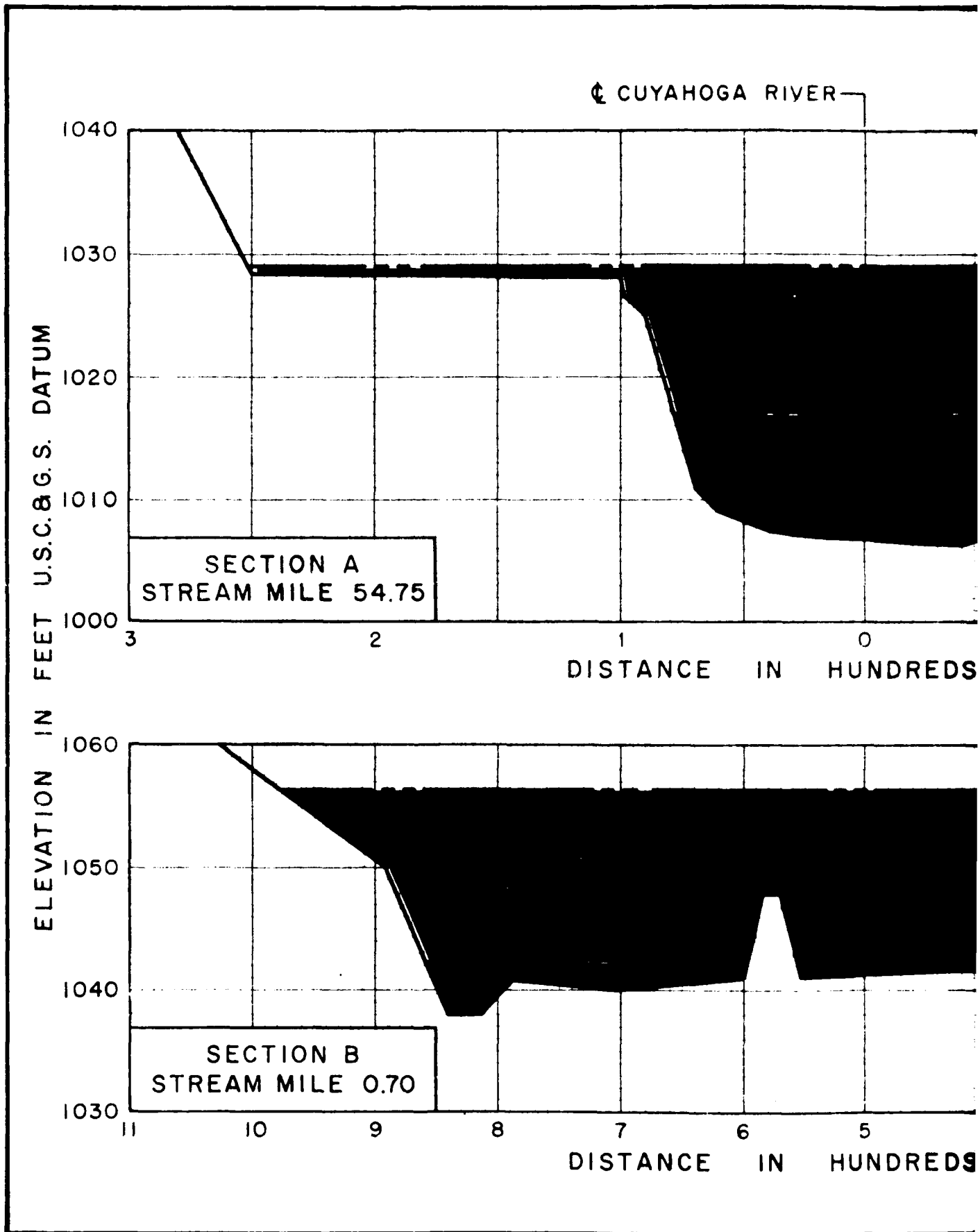
EAST MAIN ST BR

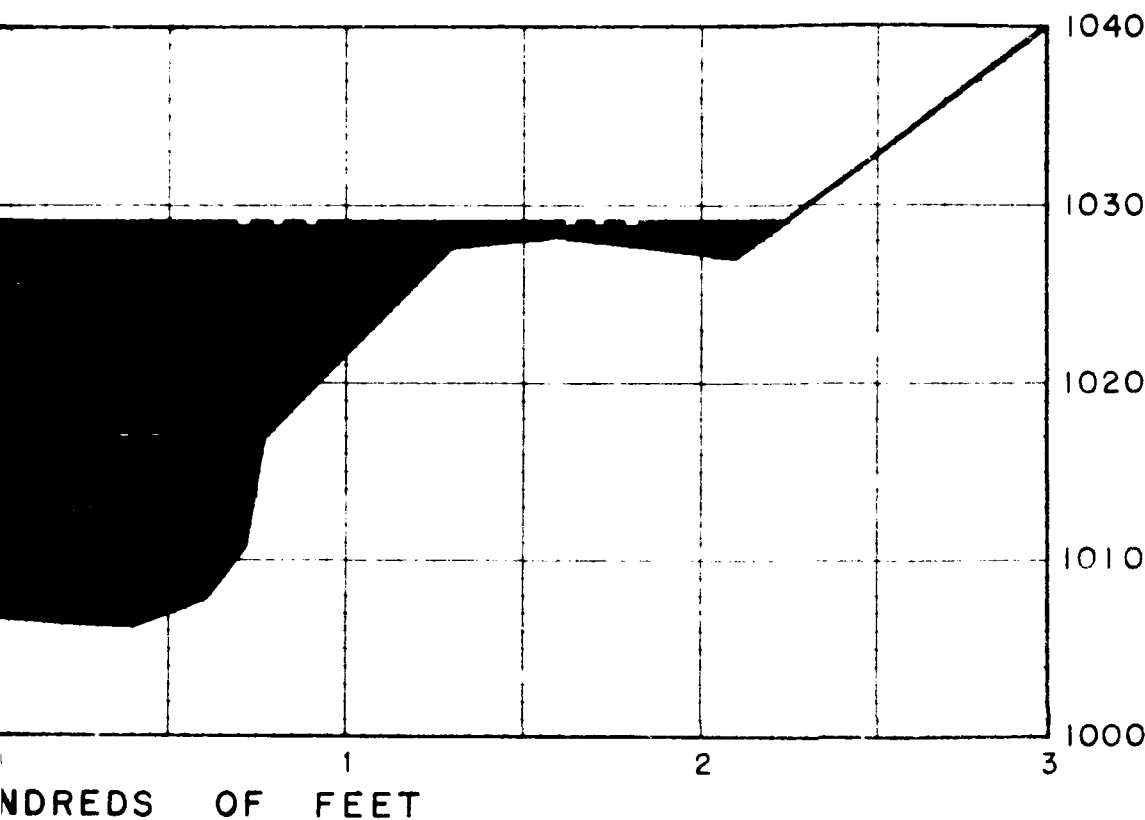
POWDER MILL RD. BR.



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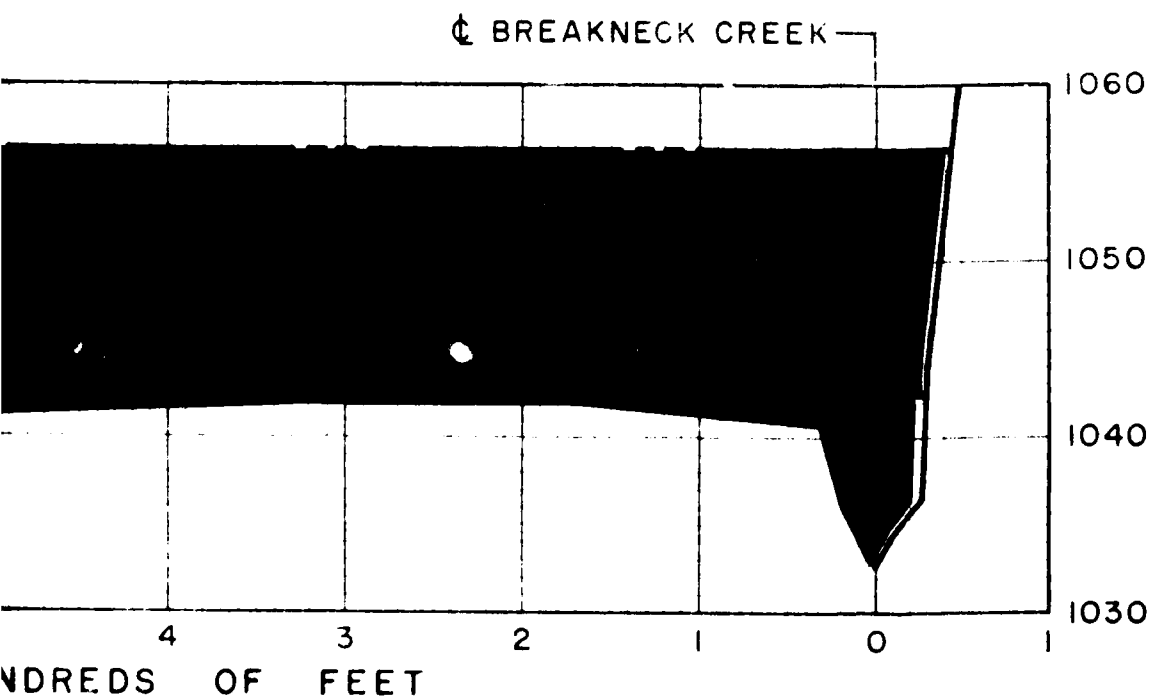
LEGEND:

 STANDARD PROJECT FLOOD
 INTERMEDIATE REGION
 APPROXIMATE GROUND

NOTES:

VALLEY CROSS SECTIONS ARE BASED ON ACTUAL FIELD SURVEYS AND GEOLOGICAL QUADRANGLE MAPS.

VALLEY CROSS SECTIONS ARE LOCATED DOWNSTREAM AND ARE LOCATED ON MAPS 7 AND 8.



CUYAHOGA RIVER
 CITY OF KENT AND
 FRANKLIN TOWNSHIP
 FLOOD PLAIN INFORMATION
 VALLEY CROSS SECTIONS
 A AND B
 U. S. ARMY ENGINEER DISTRICT
 MAY 1972

PROJECT FLOOD

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PLATE II 2

Cuyahoga River "Reference Marks" - Kent, Ohio

Reference Mark Location	:	Description	:	Elevation (U.S.C. & G.S. Datum)
Middlebury Road Bridge	:	Chiseled "+" on concrete bridge abutment (North-East Corner) at upstream right bank of Middlebury Rd. Bridge.	:	1017.62
Norfolk & Western R.R. Bridge	:	Crosscut on anchor bolt at east side of Cuyahoga River, on north east corner of N & W R.R. Br. (40' west of tracks)	:	1022.28
Kent Waste Water Pipe Br.	:	Chiseled "+" top of concrete manhole, right side of Br. (upstream from Kent Waste Water Treatment Plant)	:	1019.88
Norfolk & Western R.R. Br. (off B & O R.R.)	:	PK on top of bridge seat, left bank, downstream side. PK/red, top of timber seat, right bank, downstream side.	:	1022.74 1025.90
Fuller Park Br.	:	PK on top of 12"x12" bridge seat, left side, downstream end. In Fuller Park, opposite Prospect St.	:	1018.08
Stow St. Br.	:	Chiseled "+" on top of the downstream abutment at the left bank of Stow St. Br.	:	1028.29
West Main St. Br.	:	Chiseled "+" on top concrete retaining wall on the left bank, 28' north of West Main St. Br.	:	1033.27
Crain Ave. Br.	:	Yellow chiseled "+" on vertical rail, 20' west of tracks, 120' upstream from Crain Ave. Br. at Mile Post 117.	:	1041.90
Penn-Central R.R. Br.	:	City of Akron Monument, at waters edge, 125' upstream of the easterly pier, on the left bank.	:	1033.43
Ravenna Rd. Br.	:	Chiseled "+" on top of downstream abut- ment at the left bank of Ravenna Rd. Br. near Akron Water Works.	:	1042.18
Penn-Central R.R. Br.	:	Chiseled "+" on top of the north east abutment of Penn-Central R.R. Br. over Ravenna Rd. - downstream from Lake Rockwell.	:	1053.93

Breakneck Creek "Reference Marks"

Reference	:	:	Elevation
Mark	:	:	(U.S.C. & G.S.)
Location	:	Description	Datum
Erie-Lackawanna:	:	Standard U.S.C. & G.S. B. M. marked N-G1	1064.76
R. R. Br.	:	1934 upstream left bank of mainline R. R.	:
:	:	track.	:
:	:	:	:
Brady Lake	:	Chiseled "+" on top of wing wall on the	1049.20
Rd. Br.	:	downstream left bank (left of B & O R.R.	:
:	:	track, facing downstream).	:
:	:	:	:
Baltimore &	:	Chiseled "+" on top of abutment on the	1054.90
Ohio R. R. Br.	:	downstream right bank.	:
:	:	:	:
East Main St.	:	Chiseled "+" on top of concrete abutment	1049.81
Bridge (Rte.59)	:	on the downstream right bank.	:
:	:	:	:
Powder Mill	:	Chiseled "+" on top of stone abutment on	1052.49
Rd. Br.	:	the upstream right bank.	: